ENGINEERING NEWS-RECORD

A Consolidation of Engineering News, Engineering Record, The Sanitary Engineer, and The Contractor

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ENGINEERING NEWS-RECORD

A McGRAW-HILL PUBLICATION — ESTABLISHED 1874

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

F. E. SCHMITT, *Editor*

Volume 103 NEW YORK, DECEMBER 5, 1929 Number 23

Time for Housecleaning

ORGANIZED labor, if it is ever to achieve its purpose of advancing the welfare of the working class, must take drastic steps to rid itself of that vicious element which, operating as a local union, takes matters into its own hands and stops at nothing—even goes to murder—to accomplish its selfish desire. The attack by a gang of Jersey City caisson workers upon another group of union caisson workers, cutting the air line and then beating them as they came out of the lock, as reported in our news pages last week, is one of the most cowardly acts ever charged up to union labor. Police found the local union secretary leading the attack, indicating the approval of local headquarters to the act. Unless the real leaders in organized labor rid the movement of such vicious elements within its ranks, labor's cause will decline rather than advance.

City Manager Defeat at St. Paul

DEFEAT of a proposed city-manager charter for St. Paul on Nov. 5 puts both of the twin cities of Minnesota in the same class, since Minneapolis defeated the plan in 1926. The Minneapolis plan was a mongrel, as we stated at the time. The charter defeated at St. Paul was fairly true to form, as shown by a summary of its provisions (Oct. 31, p. 706), but had two notable defects: It was not clear-cut in the separation of legislative and executive functions, and it would have given the mayor some of the powers usually given to the city manager. How much these two points had to do with the defeat of the charter cannot be judged. Among several reasons for the defeat advanced locally the more impressive ones at this distance are strong opposition by labor, which is well represented on the present council; a desire for ward representation, instead of election of councilmen at large; and satisfaction with the commission plan in effect for the past fifteen years—without political scandals, it is said. One indication of satisfaction with the present charter is the fact that of 121,000 men and women entitled to vote only a few more than 45,000, or 37.5 per cent, went to the polls, compared with 111,000 out of 150,000, or 74 per cent, in the last Presidential election. So far as large cities are concerned, 1929 will go down as a bad year for the city-manager plan with this defeat at St. Paul and a court nullification, on a technical point, of the Indianapolis charter.

A Notable Hydraulic Experiment

THERE is a significance attached to the river model experiments described in this issue which extends beyond the fact of their distinct aid in solving a specific channel improvement problem. They are the first attempt in this country to follow the practice built up in a number of great European hydraulic laboratories of making studies of river hydraulics by constructing models of the critical sections of the stream and observing the effect of various regulating or protection works on capacity, slope, water stage, scour and other factors of stream regimen. Something of a similar character was done (as described in *Engineering News-Record* of Aug. 15, 1929, p. 242) in developing the design for the Bonnet Carré spillway, but the objective was a rational design of weir and apron rather than a determination of channel improvement hydraulics. The experiments at the University of Iowa are therefore unique in America. They are remarkable, too, in the fact that they were undertaken to throw light in a specific instance on one of the most disputed questions in the regulation of alluvial rivers and particularly of the Mississippi River—namely, the question whether loop cutoff channels will so change the water slopes as to disturb seriously the hydraulic regimen and endanger present navigation conditions and flood-protection works or whether they will actually simplify the present problem. No general conclusion can be drawn from the experiment described. It does, however, indicate a way of determining an answer, and one which it was hoped that the authorization of a hydraulic laboratory by the Mississippi flood-control bill would see employed. So far the army engineers have made no use of the authority granted. The experiment described seems to offer a sound reason why they should now do so.

Financing Bridges on Income

FINANCING a municipal toll bridge by selling income bonds to an investment banking house, as was done in the case of the recently opened Louisville-Ohio River bridge, is a totally new departure as well as an unusually significant occurrence. It represents almost the first use of this type of security to finance a municipal undertaking. Indeed, income bonds—that is, bonds assured of interest and amortization only by the income from the property—have been used only once before for bridges, if present memory serves, and that by the Port of New York Authority. No property and no public credit is pledged for these bonds, although it is quite probable that the purchasers of the Port Authority bonds have counted upon the states making them good in case of default. The same, no doubt, is true of the Louisville bonds and explains somewhat the reasonable terms upon which the bankers accepted them. The Louisville municipal bridge financing is significant both of the high credit rating the toll bridge has acquired and of the more generous attitude on the part of the public toward privately financed toll structures, especially if toll collections are limited to the amortization period. It further indicates a new understanding on the part of bankers—namely, that income is the only security behind a toll bridge bond: in other words, it is a recognition of the obvious fact that a first mortgage on a toll bridge carrying no traffic is of

very questionable value. Experience at Louisville would indicate that this method of financing might be applicable to other needed bridge projects lying dormant for lack of funds, provided, of course, it is adopted with a clear conception of its meaning and the purse-strings are wisely controlled.

Erection Problems

THE success of the erection scheme utilized in building the airship dock at Akron, described elsewhere in this issue, draws attention to the possibility of using counterweight erection or some of its several variations more extensively in engineering construction. Ingeniously simple, it constitutes a rapid means of lifting heavy members into place and lightening the load on the hoisting machinery. The most recent and best-known instance of its use on bridge work was on the two 620-ton suspended spans of the Carquinez Straits cantilever bridge in California in 1927. The 5,400-ton suspended span on the Quebec bridge, raised in 1917, was lifted without counterweights and 96 hours' time was required to raise the great mass, while each of the lighter Carquinez spans was lifted from barges to its position in the bridge in 35 minutes—due to the counterweights as well as to the smaller load. In building work, some variation of the Akron method, utilizing a combination of hoists and counterweights, would seem to be applicable to lifting the heavy long-span trusses commonly used in banks and hotels. The method has many possibilities.

Coastal Dangers

ONE of the rare yet serious hazards affecting seacoasts displayed its reality in the recent great earthquake-born wave which swept over part of the southeastern shore of Newfoundland, carrying a village or two into the ocean. A movement along an offshore fault which parallels the northeastern coast of the United States is assumed to be responsible; it must have been a great movement, being felt throughout New England and even as far west as New York State. The active seismic period in which the world is now involved gives this wave destruction more than ordinary significance as pointing to a danger which, though remarkably rare, yet compels due recognition in those regions which may be exposed to it. Earthquake study may never reach the point of being able to predict the location of all fault movements likely to occur and therefore to indicate the coasts subject to possible attack of waves set up by such movements. Accordingly, the hazard is somewhat indefinite. There need be no great alarm over this danger, in view of its rarity and its probable localization to distinct danger points. Yet in view of the destructive possibilities which it contains it is worth attention by the engineer as one of the hazards of nature.

Substituting for Detours

THE Pennsylvania paving work described in this issue has a significance beyond the fact that it represents individually a well-planned and an expeditiously performed construction operation. With equipment and procedure largely standardized, improvement in road construction lies in refinement of processes to reduce traffic delays. This was the objective in the operation which Mr. Van Duzer describes. Its particular significance is that an old method—building the road in successive half widths—was submitted to an economic analysis and planned on the basis of the findings. The plan and the measure of success with which it worked are clearly stated in the article. The broad conclusion, a most important one, is that the extra cost of the plan would have been well invested even with traffic as low as 800 vehicles a day average. This precise figure is of course based on a specific case, and, moreover, on one where an unusual length of detour was required if the road were closed, but it indicates unquestionably that a very moderate vehicle frequency warrants consideration of caring for traffic on the right-of-way instead of detouring it. There is a psychological advantage always, and frequently also an economic advantage in letting the traffic use the familiar road. Highway officials are familiar with the fact that local resentment mounts higher because a road is closed than because the detour involves a longer and slower journey. Altogether there was sound philosophy as well as a saving in traffic cost in the construction planning of the Pennsylvania highway department engineers for the improvement work described. It is incidentally of interest to note also that this is one of the largest paving operations in which high-early-strength cement was an essential factor in the construction planning.

Investigating Rock Foundations

ON THE findings of an able board of engineers and geologists the state engineer of California declines to permit construction of the proposed 492-ft. San Gabriel dam. The board condemned the site as unsafe for a high massive dam. Its report, which confirms and amplifies the findings of the earlier board named by the Los Angeles Flood-Control District (see Oct. 31, 1929, p. 699), leaves no room for doubt concerning the hazards residing in the broken and crushed rock masses at the forks of the San Gabriel River. Whether similar conditions will be found downstream, at the point where Pasadena plans to build a water-supply reservoir, is a matter that may have to wait for later determination, when excavation there has been carried deep enough to reveal the nature of the ground.

The sensational developments at San Gabriel compel attention to the fact that much uncertainty is inherent in the problem of locating a dam and undertaking its construction. Preliminary explorations are not always capable of giving adequate information on rock structure or on faulting and weathering, and a well-studied decision may be overthrown by facts brought to light after construction begins.

It may therefore be appropriate in building a large dam, whenever the advance knowledge of safe foundation conditions is not sufficient for positive assurance of safety, to begin construction under a preliminary contract covering only the excavation and involving the contingency that work may have to be abandoned as a result of its showing. Though practice hitherto has not used this expedient, the necessary liquidation of the San Gabriel contract may give proof of its advisability. Not only are dam projects progressively going to greater heights, but careful scrutiny of rock conditions has become a matter of primary faith since the St. Francis failure. For both reasons dam construction will demand foundations proved excellent not alone by borings or occasional testpits but also by the actual full-size exposure. The project therefore will be final only after the excavation is complete, and contracts will necessarily be framed accordingly.

Regional Study and Industry

BEYOND the local community, the town or city, lies the interdependent region, which represents the modern unit of engineering study. Metropolitan regions have come to receive very definite recognition in recent years; studies and sketches by W. W. De Berard in our columns have contributed to its understanding. It is known now that many of the service works on which civilized life depends, the works of civil engineering, are most effectively handled when adapted to regional rather than local needs. Unless the regional situation is studied, plans for such works are apt to involve waste, interference and reduced service.

Regional problems exist also in industry. This is the strong showing of observations made recently by a group of editors of industrial journals affiliated with *Engineering News-Record*, in the course of a fortnight's tour through New England manufacturing cities. A brief summary of the observations, abstracted last week, emphasizes the regional aspect of the situation. The tour made it clearly apparent that our six northeastern states are closely knit in their activities, their conditions of well-being and their problems. Joint study of industrial problems on a regional basis is the logical necessity for development of New England activities.

Such study has in fact been in progress for several years, by means of centralization of industrial men and organizations in a body known as the New England Council. This body was formed because industrial shifts had given currency to the question, "What is the matter with New England?" and the business organizations, utility and railroad men of the region determined to find what was at the bottom of the question and how any weaknesses in the situation could be corrected.

New England is made an industrial unit by its history of growth, by geographical relation to raw materials and markets and by the characteristics of its working population. What affects one part of the region affects other parts, and whatever is found constructive for one city or one industry has application to all. So the plan of regional study is eminently appropriate to New England; its consistent prosecution is sure to be beneficial. But there are grounds for believing that similar industrial regions exist elsewhere—in fact, that the entire country contains many unitary industrial regions which might benefit by centralized study of their problems of industrial administration and development.

Civil engineering is so closely interlinked with general industrial development as to make the major problems of the latter a subject of direct concern to civil engineers. They have a stake in the question of recognizing the existence of industrial regions and in promoting the application of centralized study and planning to such regions. They may well seek opportunity to take part in such study, not only because of the prominence already given to regional planning in the field of civil engineering but also because many elements of industrial problems—for example, transportation, plant location, layout and building design—are within the civil engineer's province.

Of what character are the joint problems of an industrial region may be usefully exemplified by New England. That region, the cradle of American industry, the early home of many important crafts, and the place where precise machines and interchangeable manufacture originated, is in a state of transition because routine quantity production tends to migrate to places nearer its markets, while specialized production requiring high worker skill is moving in. The events of this transition gave impetus to the regional study, but this latter is finding quite as much work to do in connection with permanent as with migrating industries.

Because of its age the region has many traditions, and there is a large hereditary element in ownership and management of plants. The location, grouping and layout of industries represent the slow growth of years, as in an old farmstead, often with the same effect on efficiency. A large body of skilled and willing labor has been built up as the growth of successive generations.

Aside from the element of tradition, there is the effect of the intense concentration of production which characterizes the region. In some sections industry is remarkably diversified, while others are devoted exclusively to one or a few related lines, leading to distinctly different industrial and economic conditions. In all cases, however, raw materials must be brought from distant sources, and despite a large local market the distribution of products also is distant. There are favorable and unfavorable factors in these several conditions, and some of them change rapidly because of change in consumers' habits, as in the textile field.

One outstanding fact is that New England has a large proportion of old manufacturing plants. Another is the existence of a similar pressure of old conditions and traditions in the field of human relations. Groups of factory buildings that have grown up hit or miss in cramped quarters in the heart of cities suffer from the disadvantage of inefficient floor arrangement, gloomy illumination and general absence of those facilities and conveniences which favor efficient production; such plants face unmistakable problems when the competition of newer, more efficient plants there or elsewhere comes into play. Little imagination is required to suggest the thought that the next decade or two will see large-scale replanning and rebuilding of industrial plants. Competition will lay similar stress on the modernizing of human relations—on that enlightened, stimulative adjustment of management and worker which modern practice recognizes as essential to efficiency and stability. Examples of progressive attitude in human relations are yet in the minority. Huge aggregations of productive capacity, as in the cotton industry, are peculiarly susceptible of the onset of creeping obsolescence when hampered by absentee ownership and the stagnating influence of feudal management systems.

New England also well exemplifies the value of diversification, the weakness of massed industries and the close relation of industrial development and location to the general layout and efficiency of communities. These conditions, together with those above noted, lay stress on the importance of the joining hands of industrialists in such bodies as manufacturers' associations and chambers of commerce; but equally vital, in view of the pervasive regional spread of the problems involved, is the further grouping of this co-operative work in a regional study organization like the New England Council. The larger body alone can give adequate attention to those matters whose solution depends on study broader than the local horizon.

These are strong reasons for inquiring to what extent industry in any particular location is controlled by regional factors and demands regional study; and for thereupon considering how regional co-operation may be organized. The civil engineer has an obvious responsibility toward any movement of this kind. If he fails to share in it he will be the principal loser; but the study itself will also fail of fullest fruition.

Weighted Cables Raise 360-Ton Arches in Airship Dock

Assisted by Locomotive Cranes, Counterweight System Proves Rapid Method of Erecting Huge Zeppelin Structure at Akron, Ohio

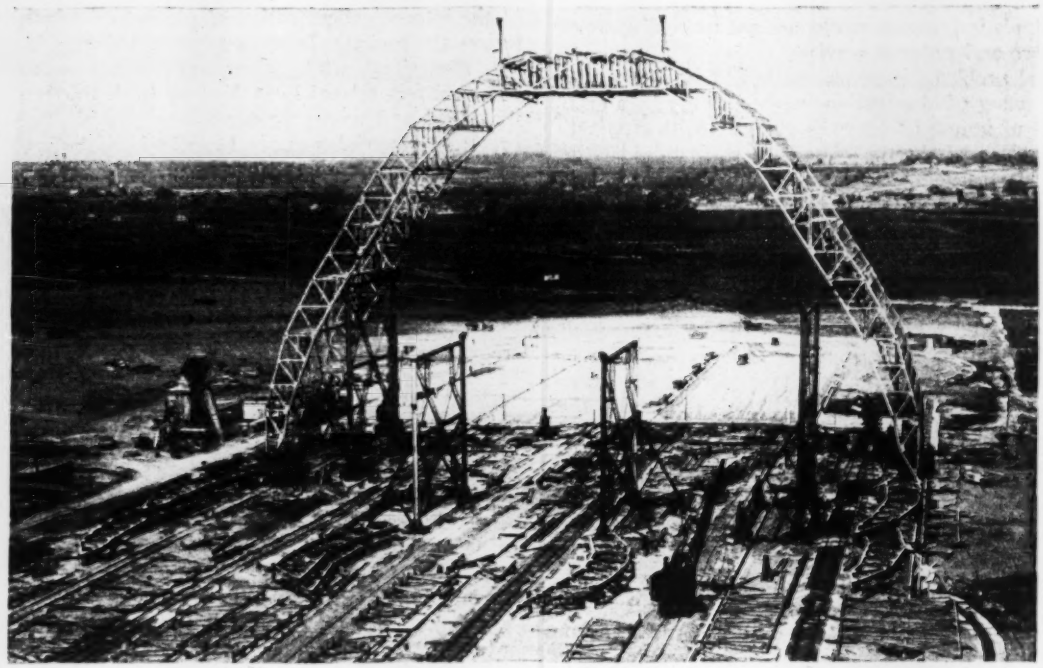


FIG. 1—FIRST BAY OF STEEL COMPLETED IN THE NEW AIRSHIP FACTORY AND DOCK AT AKRON
Steel falsework bents are being moved preparatory to starting next bay.

THE procedure used to erect the series of thirteen arch-truss ribs and fill-in bracing comprising the framework of the Goodyear-Zeppelin airship factory and dock at the Akron (Ohio) airport was quite as novel as is the structure itself. Three principal operations were involved in placing each erection unit, which comprised a complete bay consisting of a pair of ribs with rafters, purlins and bracing: first, erecting the haunch sections on steel falsework with locomotive cranes; second, assembling the center sections on similar but lower steel falsework and hoisting them to position between the haunches by counterweighted cables assisted by lines reeving over the locomotive crane drums; and third, placing the rafters, purlins and bracing in the bays between those already erected, using a stiff-leg derrick traveler on top of the erected steelwork, the same traveler later lifting into place the arch ribs of the doors at either end.

The unusual nature of the erection work is obvious from the type and dimensions of the structure. The body of the building is a semi-ellipsoid formed by a series of thirteen arch trusses of 325-ft. span, 198½ ft. high center to center of pins. It is inclosed at the ends with special doors which when shut form quadrants of spheres. They also are made up of arch trusses carried on a single pin at the apex of the roof and resting on railroad trucks on the ground. The total length of the building, including doors, is 1,184 ft. 4½ in.; the doors take up 109 ft. 2¼ in. of this length at either end. The body of the building is divided into twelve bays, ten of 80 ft. and two of 83 ft., by the arch trusses. A description of the factory and dock was published in *Engineering News-Record*, April 11, 1929, p. 583.

Grading and foundation work were both practically completed by April, when steel erection began. Grading involved removal of the top marshy soil, which was about 2 ft. deep, and the deposit of a 5-ft. fill of rather coarse mixture of gravel, sand and clay placed and rolled in 9-in. layers. This was topped with 6 in. of slag over the entire nine acres of floor area, and on this was placed a 6-in. concrete floor. Foundation construction involved about 12,000 cu.yd. of concrete divided among such principal parts of the structure as the 26 footings for the arch trusses, two semicircular door runways, two pairs of docking rails running the full length of the building and 1,000 ft. beyond at each end, a 9-ft. square pipe tunnel running the length of the building on the center line, and the concrete floor. The pedestal footings for the arch trusses are about 6 ft. deep, 15½ ft. square on the bottom and 8½ ft. square at the top. Each pedestal rests on 24 cast-in-place concrete piles driven about 25 ft. to rock. Each pair of pedestals is tied together across the building by a reinforced-concrete beam approximately 4x5 ft. in cross-section.

Since it was desired to begin construction of dirigible

airships at the earliest possible moment, the erection plan provided for the completion of the south half of the building first; prevailing winds are from the south, and it will cause less interference with airship construction to have the north end open. The steel erection plan contemplated raising the building in units, each composed of two arch trusses and the framing between. Erection of the bracing in the bays between the units would begin as soon as the first two units (four arch ribs) were placed.

The first unit erected included arch trusses 6 and 7 at the center of the building. This unit was chosen as the initial one because these arch trusses are fixed at the base, which provided an added factor of safety in testing the untried erection scheme. Arch 8 is also fixed, but the five arches at either end of the building are on rocker bearings in order to make allowance for expansion.

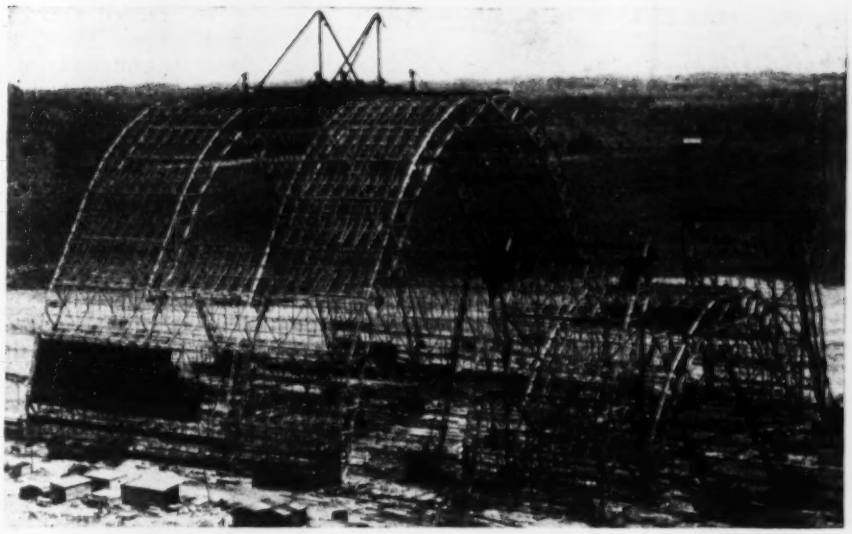


FIG. 2—GENERAL VIEW OF GOODYEAR-ZEPPELIN DOCK ERECTION, AKRON

The three principal steps in the erection plan are apparent. In the right foreground the haunches of a bay have been erected. The second step, involving erection of the center section on the ground and hoisting by counterweights and cranes, is under way. The third step, filling in the open bays with a traveler running on top of the structure, can be seen at the left.

A railroad line passes close to the structure, and two 1,200-ft. spur tracks were laid to serve the steel yard. The contractor also placed six tracks within the area of the dock to facilitate erection by means of locomotive cranes. Consideration of the use of an erection traveler was dropped because of its weight and initial cost and also because of the delay and expense incident to dismantling and reassembling its upper framing when moving it back to erect the north half of the building. The erection scheme adopted required a minimum of new erection equipment, since one 35-ton and six 60-ton locomotive cranes already on hand could be utilized, leaving only the counterweight details to be specially constructed.

Haunch Erection—For purposes of erection the bottom sections of a bay, including an arch truss at either end extending to a height of about 100 ft. above the base, were considered as haunches and erected first. A steel falsework bent as shown in Fig. 3 was first placed. It was 80 ft. wide, the length of one bay, with bearing under each arch truss. A 300-ton hydraulic jack with a 9-in. runout was built into the bottom of each of these supports as a means of adjusting the haunches when landing the center sections of the bay.

Each arch truss haunch was completely assembled on the ground, pinned at the shoe and lifted to position on

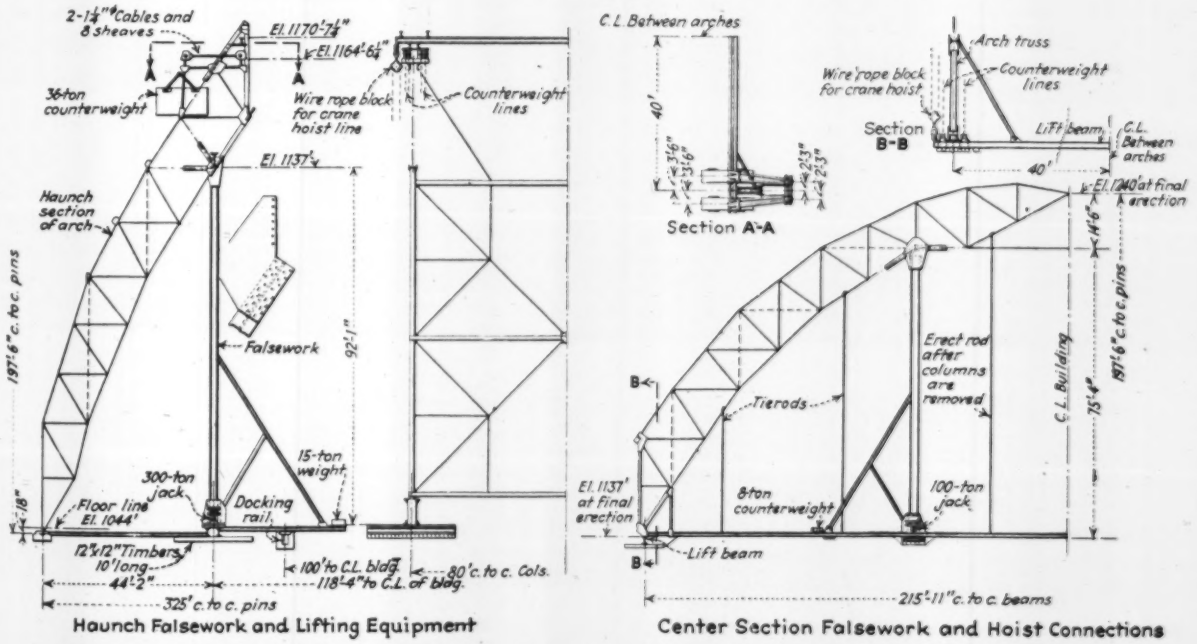


FIG. 3—DETAILS OF AIRSHIP DOCK ERECTION BY COUNTERWEIGHT AND LOCOMOTIVE CRANE COMBINATION

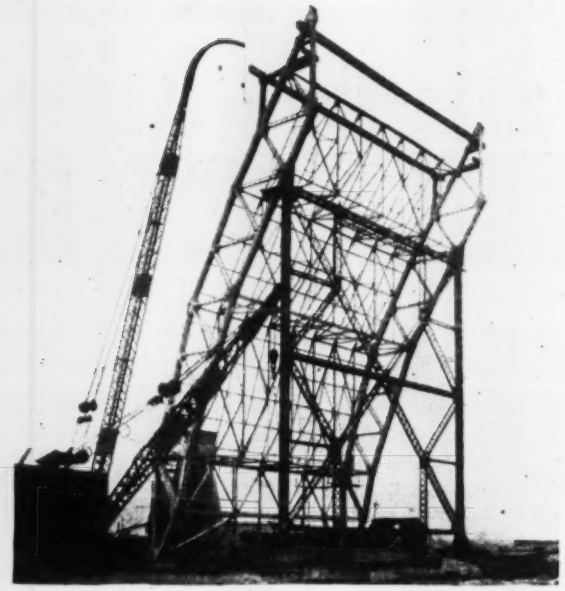


FIG. 4—HAUNCH SECTION OF ONE BAY COMPLETE
Note bracket on back of arch rib which supports counterweight sheave arm. Box girder at apex of top panel carries sheaves for locomotive crane hoisting lines.

the falsework by means of a 60-ton locomotive crane equipped with a 105-ft. boom and a 45-ft. gooseneck jib. Two of the 60-ton cranes were equipped with these long booms, and in addition to setting the arch trusses they erected all of the fill-in bracing of the rafters and the purlins.

Center Section Erection—Another important use of the long-boom cranes was to place the brackets, sheaves and other details at the top of the arch truss haunches to carry the counterweights used in erecting the center section of the bay. This equipment is shown in Figs. 3, 5 and 6. It consisted of brackets erected out from the top

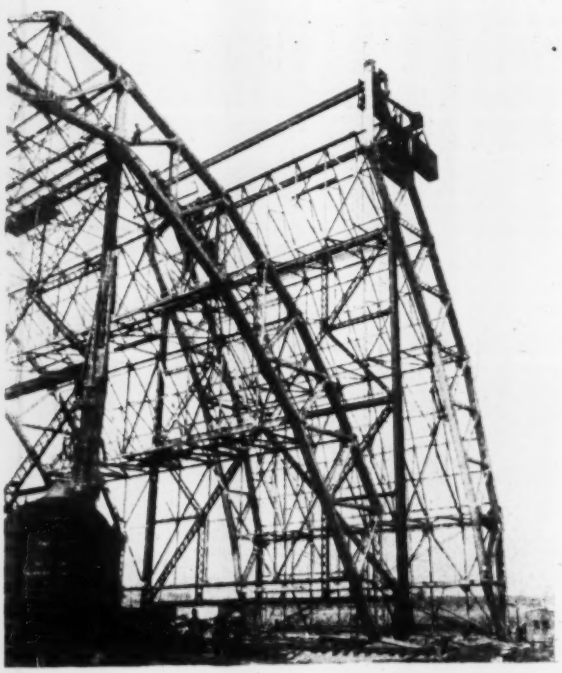


FIG. 5—ERECTING CENTER SECTION ON GROUND
Note counterweights at top of haunch sections.

chords of the arch trusses (Fig. 4) as supports for arms which carried sheaves on either end for the counterweight lines. The sheaves on the inside end were directly over the center section which was to be raised. The counterweights were hung below the rear sheaves and being thus set back from the trusses cleared the maximum amount of bracing as they moved downward. A girder made up of two I-beams spanning the length of the bay from arch to arch at the very top of the haunches and entirely independent of the counterweight layout carried the blocks and falls which reeved to the locomotive crane drums.

The center section of a bay was erected directly below its final position in the building. Steel bents with 100-ton jacks in the bases of the legs similar to those in the falsework of the haunch sections supported the center section during erection, the jacks serving for adjustment in driving the center pin. Locomotive cranes were also used to

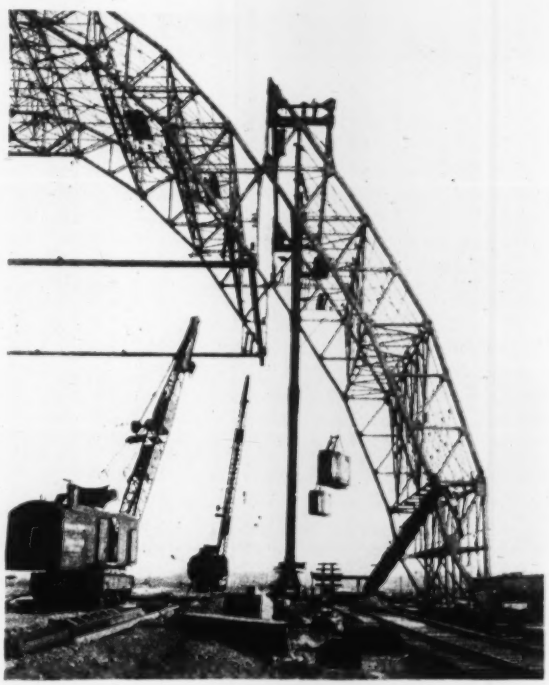


FIG. 6—COUNTERWEIGHTS AND LOCOMOTIVE CRANES IN ACTION RAISING THE CENTER SECTION
View taken as jacks in haunch falsework are being adjusted to permit center section to pass.

raise all of the center section steel after as much of it as possible had been assembled flat on the ground.

As shown by Figs. 3 and 6, the bottoms of each of the arch trusses were tied together across the building by a pair of laced channels which served as bracing during lifting. Lift beams made up of boxed I-sections running the length of the bay supported the center section arch trusses on the ground and later these were pinned to the hoist lines running from the cranes and the counterweights.

With erection of a center section complete on the ground, the falsework bents were taken out and moved ahead two bays ready for the next center section. Vertical ties as shown by Fig. 3 were installed to stiffen the center section, and the counterwight and crane hoist lines were attached.

In raising each center section, two 36-ton counterweights (steel boxes filled with punchings) acted at each

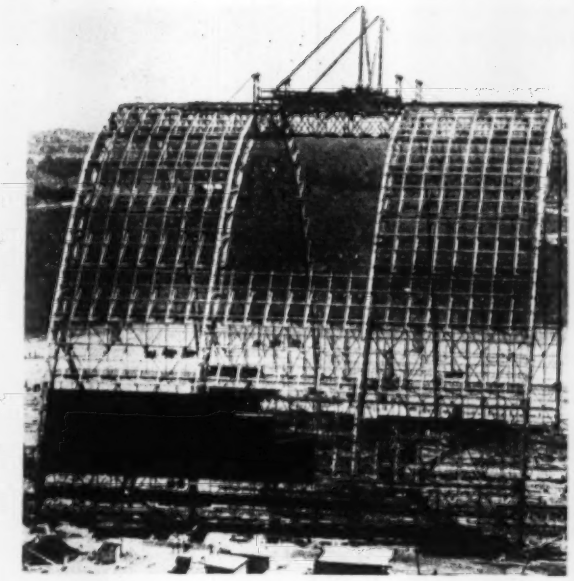


FIG. 7—TRAVELER FILLING IN OPEN BAY
Note stub-columns with block and falls on top of arch trusses used to lift traveler to position. A few of the roof plates have been erected.

corner. These counterweights balanced 80 per cent of the total load of 360 tons. The remaining 20 per cent, equivalent to 20 tons on a corner, was lifted by utilizing four of the 60-ton locomotive cranes as hoisting engines. Such large cranes were used in order to have a great excess of power available in case of accident or fouling of the counterweight lines. These center sections were raised in about half a day. Connection to the already erected haunch sections was effected by utilization of the 300-ton jacks in the haunch falsework legs and also by slacking off the ties across the center sections. These operations provided horizontal and vertical adjustments sufficient for the center section to clear and then to be maneuvered into place. Incidentally these adjustments caused a complete change in the type of stresses, the cantilever stress in the haunch sections and the roof truss type stresses in the center sections being changed to arch stresses. The transfer was successfully accomplished without overstressing any of the members, according to statements made by the erector.

Erection by Traveler—Six bays, including all arch trusses except one at the north end, were completely erected by the counterweight-crane combination. There

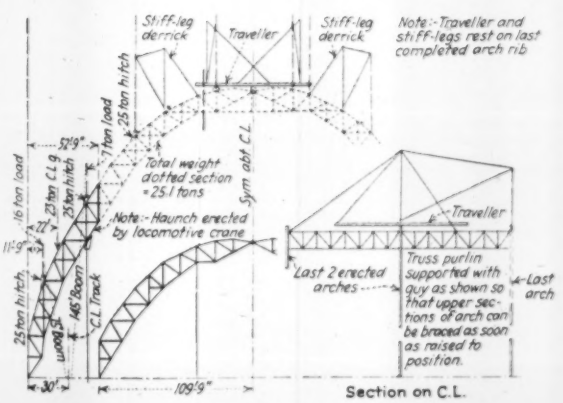


FIG. 8—ERECTION EQUIPMENT LAYOUT FOR LAST ARCH RIB

remained to be erected the purlins and rafters in the alternate bays, the arch truss at the north end and the doors. For all of this work, a traveler carrying two 30-ton stiff-leg derricks with 90-ft. booms, running on top of the structure, was used. The traveler was assembled complete on the ground in the open bay between the first two bays erected. Four stub columns or steel ginpoles carrying 25-ton blocks and falls were placed on top of the arch ribs, with hoist lines dropping to each of the four corners of the traveler. Again, by the use of the locomotive crane drums, the traveler was hoisted to the top of the structure, where turnbuckles and rods were substituted for the set of falls so that the traveler was made secure.

The lattice rafter struts were then raised with sets of falls from the arches at each end and bolted into place under the traveler, after which the bracing was filled in with runner lines. The turnbuckles were slacked off and the traveler was lowered to the lattice rafters. Then, running on a temporary track, it filled in the steel in the open bays, working from the center to the south end, and then, returning to the center, it similarly erected the open bays in the north half of the structure.

Since there were thirteen arch trusses in the building and twelve of them were erected in pairs, there remained a single arch truss at the end to be erected by itself. The haunches of this arch truss were erected on the steel

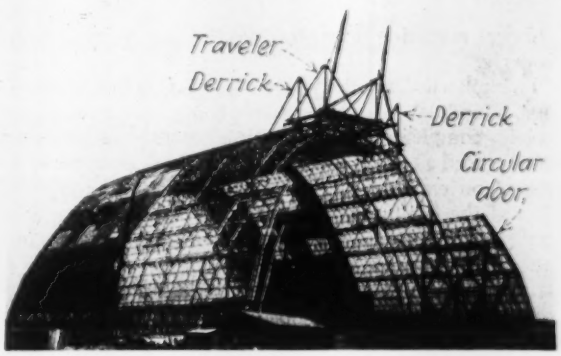


FIG. 9—ERECTING FRAMEWORK OF SPHERICAL DOORS
Doors erected in full open position so that they could be supported on main building framework. Falls from both the traveler and the fixed stiff-leg derricks utilized.

falsework, and the center section was assembled on the ground. The purlin trusses along the top of the last bay were cantilevered out from the last erected arch truss and guyed as shown by Fig. 8. They were thus available for immediate connection to the center of the thirteenth arch, which was erected as follows:

The traveler standing between the last two arches erected raised two stiff-leg derricks, which were placed one on each side of the center of the building about halfway between the ground and the traveler booms (Fig. 8), and with the two booms on the traveler and these two stiff-leg derricks, the center section of the thirteenth arch truss, which weighed 50 tons, was hoisted into place without difficulty and set on the lower sections of the arch, which had previously been erected on the falsework with the locomotive cranes. The traveler and derricks were then moved forward into a similar position on this thirteenth arch and, following the same procedure, erected the two diagonal arches at the end of the building. These diagonal arches are introduced to allow the

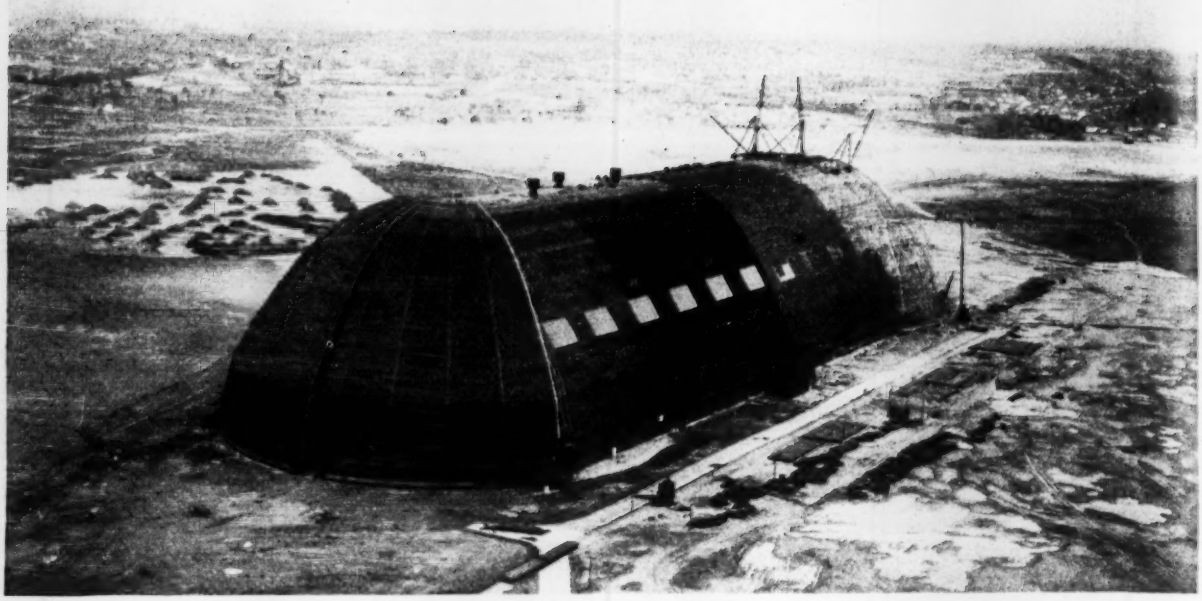


FIG. 10—ZEPPELIN DOCK NEARING COMPLETION
Doors are completed on rear end. Traveler and stiff-legs erecting north doors at far end of building. Present used part of Akron municipal airport at right.

spherical revolving doors to close the end of the building properly.

The spherical section doors were erected as shown by Figs. 9 and 10, the south doors being erected when the traveler completed that end of the building and the north doors placed as a final operation. A track was laid on the ground on each side of the building at the ends, which allowed the locomotive cranes with 105-ft. booms to set up the lower sections of the arches forming the doors. In opening, these doors will roll back against and outside the main arches on each side of the building, and they were erected in their full open position. Each of the five arch ribs in each door was put up in three sections, the lower sections being erected and filled in by locomotive cranes, the upper ends of each of these sections being supported from the main arch ribs by short steel struts. The next five sections were then placed with the derrick booms and filled in and supported on five more short steel struts from the main structure. The upper five sections were then placed with the traveler booms.

Personnel—Steel erection was carried out by the American Bridge Company under James L. de Vou, central district erection manager, who developed the counterweight erection system, while general supervision of the erection was in the hands of Richard Khuen, Jr., general manager of erection, American Bridge Company. Dr. Karl Arnstein, vice-president and director of engineering of the Goodyear-Zeppelin Corporation, developed the idea of the airship factory, including the exterior curves of the building.

The design of the hangar itself was executed by Wilbur Watson & Associates, of Cleveland, under the direction of Wilbur J. Watson. W. C. State is chief consulting engineer for the Goodyear Tire & Rubber Company. Those in charge at the job are R. W. Vail, supervising engineer, Goodyear-Zeppelin Corporation, and R. W. Stuck, resident engineer, Wilbur Watson & Associates.

Geological Survey Extends Map of the Country

In its annual report recently released, the U. S. Geological Survey states that during the year ended June 30, 1929, it did geologic work in 42 states and Alaska and that its topographic work amounted to 17,333 square miles in 29 states, the District of Columbia and Hawaii.

Of the total amount of work done during the year by the topographic division, 12,956 square miles represents new surveys and the remainder consists of resurveys and revisions. The total area mapped to date is 1,327,334 square miles. Nine states and the District of Columbia are now entirely mapped and the percentages in other states range from 8 to 88.6 per cent. Of the total continental United States, exclusive of Alaska, 43.6 per cent has been mapped. Aerial photographs furnished by the Air Corps of the U. S. Army were of assistance in the topographic mapping. A base map of California was prepared and the base map of Arkansas was revised.

Work on water resources is done largely in co-operation with other federal bureaus; with state, county and municipal agencies; and with permittees and licensees of the Federal Power Commission. Including the co-operative work, the study of surface waters, which consists primarily of the measurement of the flow of streams, was carried on in 47 states in which 2,238 gaging stations are being maintained. Investigations relating to groundwater, power or reservoir sites were made in 22 states. Research into the principles of hydrology has been continued to provide a more secure basis for groundwater investigations. Co-operation was continued with well drillers' associations with a view to developing high standards and better results in water-well drilling.

There was a net increase of 245,808 acres in the area included in power reserves, making a total of 6,459,570 acres in twenty states and Alaska on which about 15,000,000 continuous horsepower can be developed.

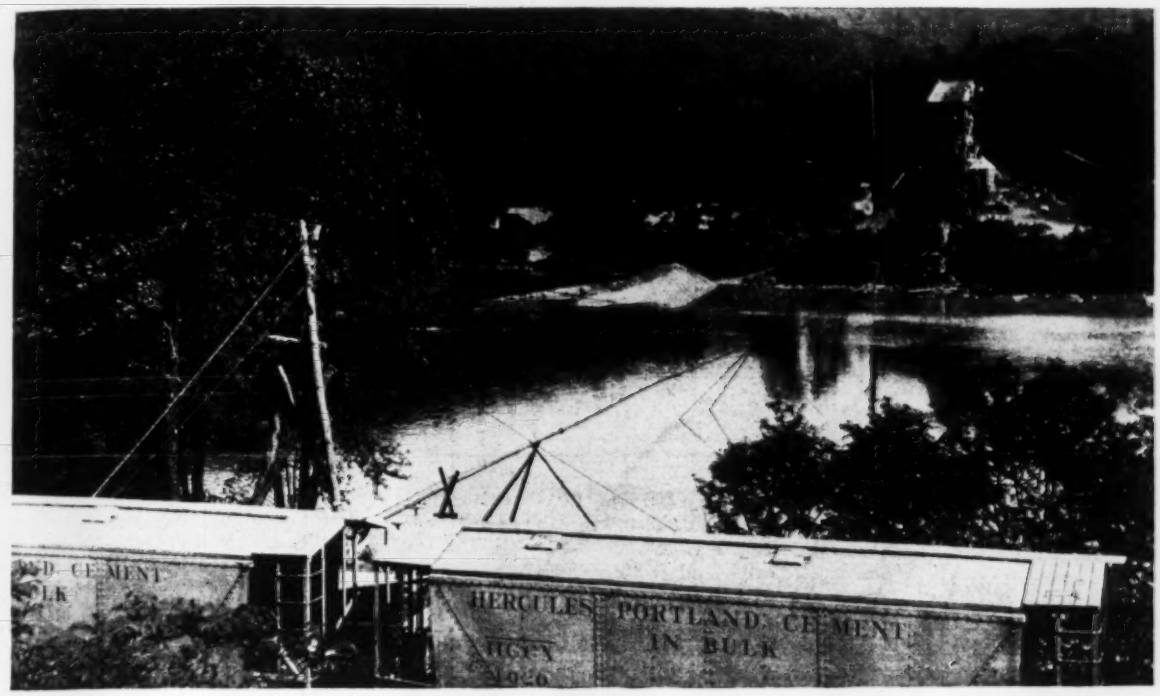


FIG. 1—PUMPING BULK CEMENT ACROSS ALLEGHENY RIVER, WARREN COUNTY, PENNSYLVANIA

Bulk Cement Pumped Across River for Concrete Highway Job

600 Bbl. Daily Supplied by 3-In. Pipe Line—Separate Cement Compartments on Trucks for Batch Delivery

By Morris Kind

President Hercules Cement Corporation, Philadelphia

ALL of the cement required for a 16-mile Pennsylvania state highway contract, along the east side of the Allegheny River in mountainous Warren County, was pumped 768 ft. to a central batching plant from a point on the only available railroad, located on the opposite side of the river. Transportation by trucks from railroad to the job was impossible because no bridges cross the stream along the entire length of the contract. Bulk cement was pumped at a rate of 600 bbl. per day through a 3-in. pipe line hung from a suspension cable. The cement was batched along with sand and gravel at a central plant and loaded into special trucks having separate compartments for the cement, as shown in Fig. 3. Sand and gravel were taken from the river at a near-by point.

A general view of the plant layout is shown in Fig. 1, and the cement-handling plant is detailed in Fig. 2. The cement was unloaded from the cement company's patented special bulk cars (Fig. 4) with four unloading hoppers on each side dumping into two parallel screw conveyors, one on each side of the track. These two conveyors fed a third screw

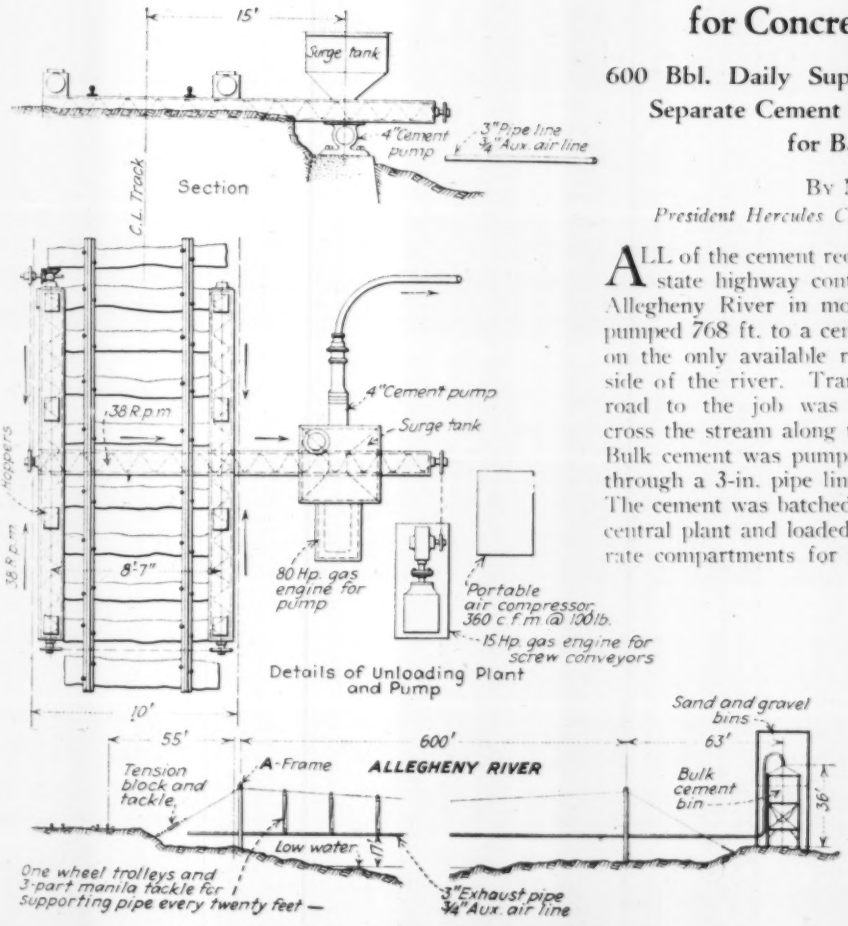


FIG. 2—DETAILS OF CEMENT-HANDLING PLANT

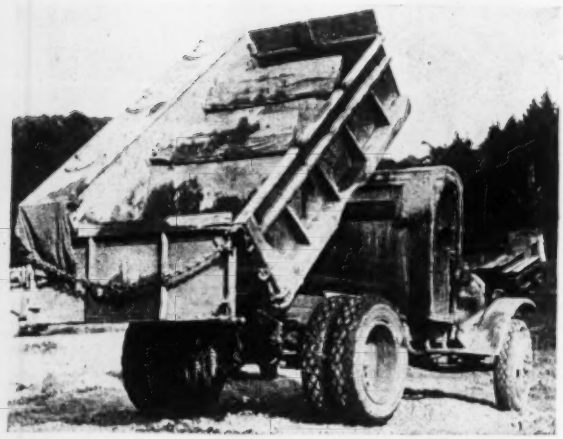


FIG. 3—SPECIAL BATCH TRUCKS WITH SEPARATE WATERTIGHT COMPARTMENTS FOR BULK CEMENT

conveyor placed at right angles to the track and feeding direct to a cement pump. A gasoline-operated portable compressor supplied the pump with 360 cu.ft. of air per minute at 100-lb. pressure. From the pump a 3-in. pipe line led across the river to the cement batcher bin.

The pipe line was supported by a suspension cable swung from an A-frame on each bank. Tension on the cable was adjusted by a block-and-fall connection on one end. Hangers from the cable to the pipe, spaced on 20-ft. centers, consisted of double blocks and falls fastened to single pulleys riding the cable. This arrangement kept the pipe line level. An auxiliary ¾-in. air pipe line was fastened to the top of the cement pipe to supply air for use at the batcher bin if required.

This method of handling cement proved not only entirely practicable but economical as well. Only two men were required to operate the cement plant, one looking after the unloading of cars and keeping the pump going and the other loading trucks at the batcher plant. Also, considerable saving resulted to the contractor in the purchase of bulk rather than sacked cement.

To meet the requirements of the Pennsylvania state highway specifications, special bodies were designed for the delivery trucks to permit the weighed amount of bulk cement for each batch to be transported from the batching plant to the mixer without coming in contact with the sand or gravel. The cement compartments were provided with watertight covers and proved entirely satisfactory.

The York Engineering & Construction Company, of York, Pa., was contractor on the project. T. C. Frame was resident engineer in charge for the state.

FIG. 4—UNLOADING CEMENT FROM SPECIAL BULK CAR

Registration in Disfavor With San Francisco A.S.M.E.

Representative of the Section to the Parent Body Instructed to Express Disapproval at the National Meeting

VOICING strong disapproval of engineers' registration, the San Francisco Section, American Society of Mechanical Engineers, at a meeting on Nov. 7 voted to instruct its representative to express this sentiment at the national meeting of the society. The action of the section followed papers presented by prominent local engineers representing both sides of the subject and an open discussion from the floor. The speakers for registration were L. F. Leurey, consulting electrical engineer, and C. H. Snyder, consulting structural engineer; speakers against registration were Walter Stalder, consulting geologist, and J. D. Galloway, consulting civil engineer.

Arguments for Registration

Speakers in favor of registration quoted at length from the article by C. J. Ullrich in *Engineering News-Record*, Feb. 7, 1929, p. 229, and pointed out that the public has proved to be little interested in the general subject but that it is an inevitable result of the increasing complexity of civilization and is bound to extend to more occupations in order more adequately to protect the public. Laws regulating professions such as medicine and law, it was pointed out, have proved of great value to the public and no serious attempt has ever been made to abolish them. Thus similar measures for engineers would elevate the members of the profession to a legal status and tend to eliminate therefrom the unfit and the quacks. Standards would be raised and the term "professional engineer" would become known to the public as a term defining a dignified profession and not a loose expression applied to everyone from locomotive drivers to garage mechanics.

Arguments Against

Speakers disapproving registration pointed out that the authority for such measures depends on the not too well-established interpretation of the police power of the state to conserve the public safety. Issuing licenses to persons capable of passing the minimum requirements necessary for legality would not protect the public; supervision over engineering plans and construction constitutes the only feasible means for providing public safety. This side further contended that licensing of private enterprise is fundamentally contrary to the spirit of American institutions and makes for false security, since it establishes in the public mind an idea that "registered" and "competent" are synonymous terms.

In addition, the inevitable "grandfather" clause seriously weakens any registration law for almost a generation after passage and there is extreme danger that later the controlling board would decline into a mere political body after the enthusiasm which brought the act into existence wears out. The honor of the profession, it was contended, is built upon integrity and honesty to which a state certificate would add nothing of value. A more fitting way to raise the standards of the profession, it was suggested, is from the inside through the work of technical societies.

Fig. 1—Suspension Bridge Over Rio Quequen Grande in the Argentine Utilizing Continuous Stiffening Girders

Thirty-two-Rope Cable Suspension System on South American Bridge

Sixteen Ropes Independently Anchored Compose Each Main Suspension Member of 492-Ft. Rio Quequen Crossing—Stiffening Girder of Box Section Continuous Through Towers

By Carlos G. Gerstrom
Civil Engineer, La Plata, Argentina

THE Quequen bridge is the most important suspended structure yet built in the Argentine. It improves the means of communication between Necochea and Loberia, Province of Buenos Aires, by replacing an established ferry service. The floods in the Rio Quequen Grande are often unusually severe, the current in certain instances having attained a velocity of 4 m. (about 13 ft.) per second. Because of this hydraulic feature of the river, the soil conditions at the site, future shipping requirements and the fact that supports within the bed of the river were potentially dangerous (evidence of this being supplied by a collapsed cantilever bridge near by), a suspension design was selected.

In general, the design departs from common practice by the fact that a continuous stiffening girder is used, which bridges the river in three spans, a main span of 150 m. (492 ft.) and two side spans of 60 m. (196 ft.).

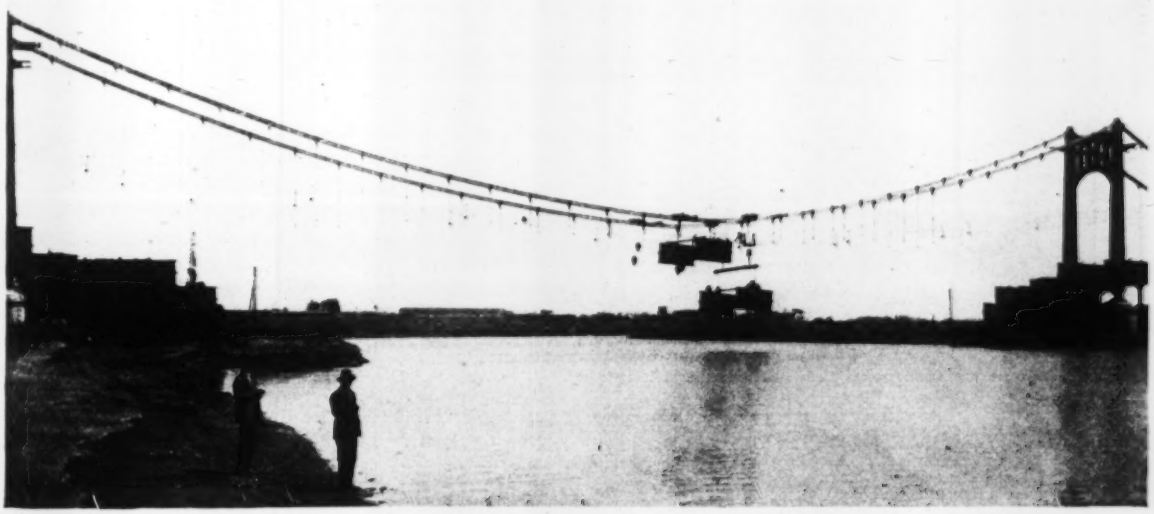


FIG. 2—ERECTING MAIN SPAN CONTINUOUS GIRDER
Two sections of girder are in place, hanging from suspenders, and cableway traveler has brought other sections from shore and is ready to hoist them into place.

The roadway, of hardwood blocks on a 2-in. concrete base, is 6 m. (nearly 20 ft.) wide, and is flanked on each side by 3¼-ft. sidewalks. Accordingly, the spacing between cables is 8.80 m. (28⅔ ft.). It is planned to bracket the sidewalks outside the girders when increasing traffic demands a wider roadway.

Towers—The rocker type of tower was adopted. Each leg consists of eight supporting webs of angles and plates tied together at 2.5-m. (8.2-ft.) intervals with horizontal splice plates. The legs are closed by cover plates to harmonize with the box-type stiffening girders. The portal bracing of each tower consists of an upper cross-girder and an arch tied together by vertical ribs as shown in Fig. 3. A cross-member beneath the roadway braces the portal against wind.

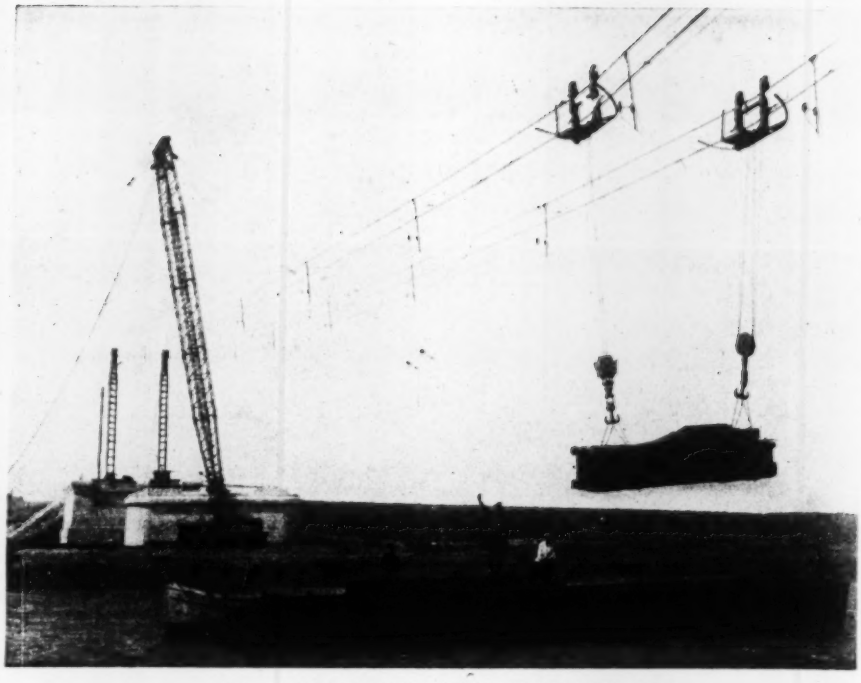


FIG. 4—UNLOADING STEEL BY CABLEWAYS
Cableway towers on abutments in rear. Tall latticed tower on main pier used to erect main bridge towers.

FIG. 3—TESTING QUEQUEN BRIDGE WITH LOADED TRUCKS
Note the cables composed of sixteen ropes each. Also the adjustable suspenders and method of attachment.

In the shoe of each tower leg the upper steel casting has its lower face finished to a spherical surface of slightly different diameter than that of an intermediate forged steel device placed between the upper and lower castings to absorb secondary stresses. Because of the continuity of the stiffening girders, the tower cover plates are discontinued on the legs near the bottom.

Cables and Suspenders—The suspension system consists of 32 ropes (16 on a side), each of which is independently anchored. Because of the coastal location of the bridge, spiral galvanized rope was adopted, each rope containing 169 wires of 4.4-mm. (0.173-in.) diameter. The wires of each rope are wound in seven concentric layers, being twisted in alternate directions with an angle of twist of 18 deg. The main cable sag is one-ninth of the span; the side span was given such a sag as to balance the cable pull under dead load.

Suspenders, consisting of steel bars 80 mm. (3.15 in.) in diameter, provided with screw and nut adjustment, are spaced along the cable at 5-m. (16-ft. 5-in.) intervals. Connections of the suspenders to the cables are made by four vertical flanges, as may be seen by Fig. 3. The cable saddles on the top of the towers are fixed.

At the anchorage the cables are set directly into cast-steel sockets. After the rope is inserted into the truncated cone of the socket, the wires are pried apart, the ends are bent to form hooks and the cavity of the cone is filled with fusible metal.

Stiffening Structure—A continuous girder was adopted for stiffening purposes. It is made of two side plates 2.5 m. (8.2 ft.) high and a top cover 80 cm. (32 in.) wide. The bottom of the girder is left open to facilitate maintenance. From one to four reinforcing flanges are used, depending upon the bending moment, and the side plates are stiffened at intervals by inner and outer ribs. The girders are provided with double bearings at the towers to withstand reversed reactions. The bearings are fixed in one tower and movable in the other. At the abutments the girders are rigidly anchored down. As

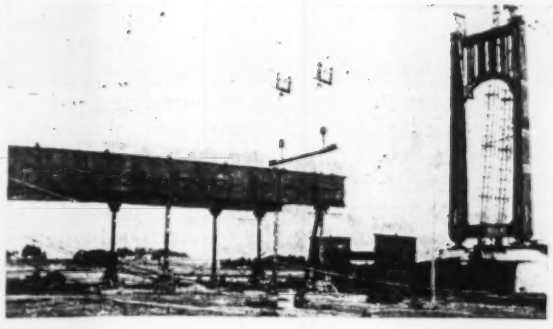


FIG. 5—ERECTION OF SIDE-SPAN STIFFENING GIRDERS ON FALSEWORK

Cable erection was carried on simultaneously, and one of the frames which lifted the cables may be seen on the top of the main tower. Cableway with equalizer beam placed girder sections.

may be seen by Fig. 1, the depth of the girder increases at the towers, the maximum increase being 1.25 m., giving a total depth of 3.75 m. (12.3 ft.)

The stress calculations followed the method explained by Prof. Müller-Breslau in his book, "Die Graphische Statik der Baukonstructionen, Band II, 1925." Ten loading arrangements were assumed in the analysis, and the study took into consideration 55 sections of the girder with varying moments of inertia. With the span loaded with 1,350 kg. (2,977 lb.) per linear meter, the calculated center deflection of the girder is 34 cm. (13⅜ in.) or 1/434th of the span.

Foundations—The main piers are of concrete, resting on 95 reinforced-concrete piles driven to rock at a depth of 10 to 12 m. (32 to 40 ft.). The anchorages, which also serve as end abutments, are concrete boxes 17 m. (56 ft.) long, and 16 m. (53 ft.) wide, and of a depth varying from 11 to 12½ m. The anchorage chambers, located 17 m. (56 ft.) below the masonry top, are accessible for inspection and maintenance by the shaft through which the cables reach the anchorage beam.

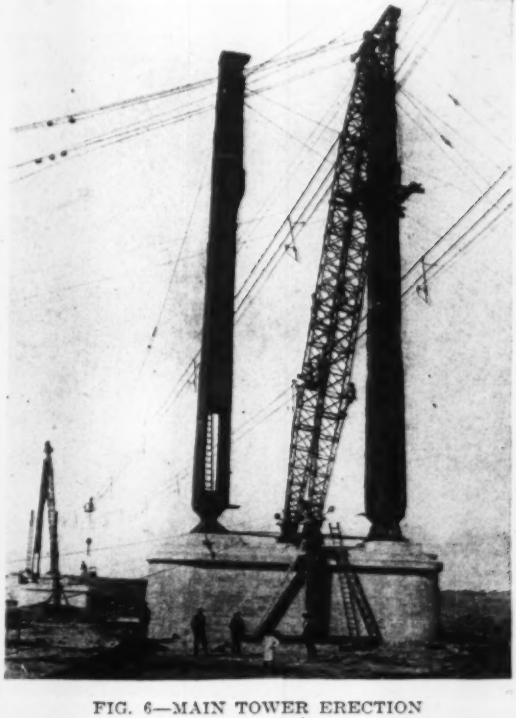


FIG. 6—MAIN TOWER ERECTION

Openings through bottom of tower legs permit passage of continuous stiffening girders.

Erection—All materials and plant for erection purposes were shipped from Cherbourg to Quequen Port, where they were reloaded and towed 5 km. (3.1 miles) upstream to the bridge site. The maximum weight of steel members handled was 16 tons. For unloading materials at the bridge site, the contractor installed two cableways with towers resting on the respective anchorages.

The erection of the main towers was done by means of a derrick placed on the main piers, as shown by some of the accompanying illustrations.

Before the cables were raised it was decided to stretch them to determine the elongations which they would assume under dead load and thus calculate the necessary suspender adjustments. Loads were applied by means of a hydraulic jack and it was noted that elongations were not the same for each cable, some of the difference being attributed to different twists in the rope. In addition to this, there were the variable temperature conditions and the inequality of the bases on which the cables were stretched. After all the cables were measured they were pulled along the bridge, secured to the anchorages and raised to the saddles by means of frames mounted on the tower tops.

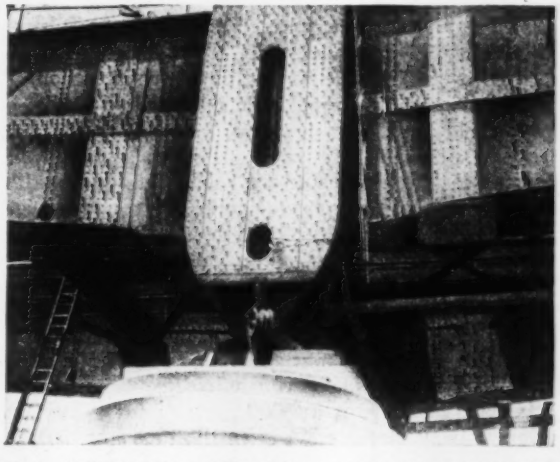


FIG. 7—STRUCTURAL DETAILS AT BASE OF MAIN TOWER

Note continuous girder splice consisting of a 6-ft. section passing through the tower leg attaching to the side span girder on one side and the main span girder on the other side of the tower leg.

The stiffening girders in the side spans (Fig. 5) were erected on falsework at the same time that the cables were being lifted. Sections of the center-span girders were hauled by the cableway and raised into position by a traveler running on the cables and controlled from the anchorages.

The design and construction of the Quequen bridge were in charge of P. Palazzo, chief engineer of the highway department, and the writer acted as resident engineer. Material was supplied and erection done by the French contracting firm, Chantiers et Ateliers de la Gironde.

Requirements for Building Exits Standardized

Requirements for building exits have been standardized in a code recently approved by the American Standards Association and made available for adoption by state and municipal authorities.

Road Reconstruction Without Detouring

Replacement Problems on a Portion of the Lincoln Highway in the Mountainous Sections of Pennsylvania

By W. A. Van Duzer
Assistant Chief Engineer, Pennsylvania Department of Highways, Harrisburg

IMPROVEMENT of a Lincoln Highway section in Westmoreland County, Pa., during the past season involved some unusual construction and traffic-handling problems. Between Greensburg and Ligonier this 3-mile section of highway traverses the narrow Loyalhanna Creek Valley. No parallel roads, either improved or unimproved, were available for use during construction.

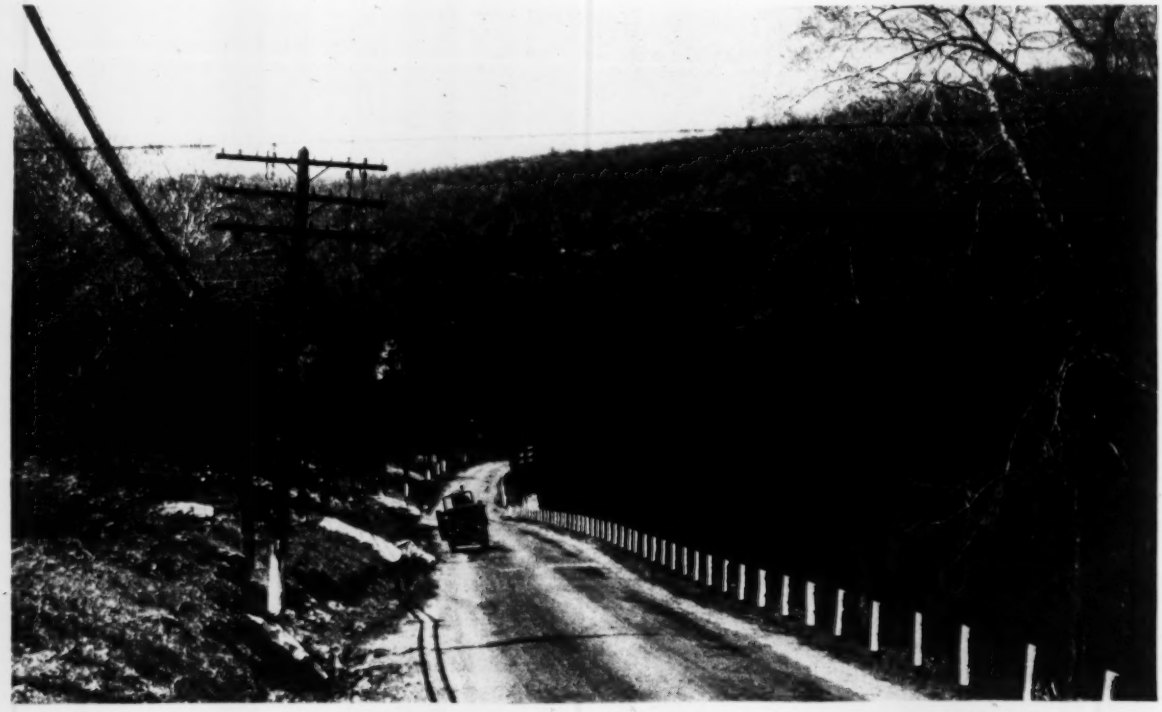
Had traffic been detoured over side roads, 56 miles of travel would have been necessary in order to cover 15 miles of the Lincoln Highway—41 miles of added distance for each vehicle using the road. In addition, this detour would have involved 4 miles of congested and circuitous city streets with their attendant delays and the uncertainties of drivers unfamiliar with the route.

Traffic counts showed that approximately 2,400 vehicles used this road as a daily average throughout the year. Holidays and week ends during the summer increased this volume as much as four times. The added cost to the traveling public if required to use this detour would have been about $10,000 per day for vehicle operation alone, entirely aside from the time lost, hazards and anxieties. It is believed that the additional cost of constructing the road following the plan which was used, as compared with the usual method whereby the public is excluded from the highway during the construction period, was about equal to the sum just mentioned as representing a single day's added cost to the public had all traffic been required to use the detour. In addition to this, maintenance costs in providing a safe and convenient roadbed for public travel were minimized.

The plan followed necessitated the carrying of traffic over the right-of-way during the entire construction period. Two lanes of traffic were provided for wherever possible. Alternating files of one-way traffic were maintained around steam-shovel operations and sections of concrete pavement during curing periods. The problem was: first, how to accommodate safely one-way traffic with delays not exceeding ten minutes to a section; second, how to schedule the work to insure its completion during the 1929 season.

Grading—By the use of five power shovels, grading operations were speeded up to the maximum. A grading chart was developed which scheduled this phase of the work in such a way that traffic could be taken care of without difficulty. In deep cuts and fills the new grade was secured using the half-width method. The new alignment of the highway deviated from the old in many places to the extent that one-way traffic within a given grading operation limit was minimized, so that delays were kept within the ten-minute period which had been set as a maximum. This was accomplished in spite of the fact that the earthwork quantities averaged 25,000 cu.yd. per mile, most of which was encountered on the western half of the project. The actual grading operations closely followed the prearranged schedule, with the result that only the expected traffic delays were experienced.

Pavement Laying—In scheduling the laying of pavement quite a different problem arose. The preliminary study indicated that one of the most important factors affecting the delay experienced by the traveling public at a given operation was the length of roadbed over which single-file traffic had to be maintained. Obviously, to



SECTION OF LINCOLN HIGHWAY RECENTLY CONSTRUCTED
Showing the grades and alignment that were corrected and a general view of the mountainous section through which the road was built.

avoid inconvenience, these sections should be as short as possible.

Under Pennsylvania highway departmental standards, concrete pavements are open to traffic when test beams molded simultaneously with the pavement reach a predetermined modulus of rupture. These strength requirements are based upon pavement thickness as well as upon the types of vehicles using the highway. On this particular project a modulus of rupture of 550 lb. was set as the minimum value. Based on the department's experience with standard paving concrete—that is, a 1:2:3½ mix using standard portland cement—this modulus of rupture is secured in from ten to fourteen days. It was manifestly impracticable to construct this project in short sections of half-width pavement if a curing period of approximately two weeks was necessary.

PHOTOGRAPH TAKEN FIVE MINUTES AFTER THE ONE-WAY TRAFFIC WAS STARTED

Clearly, high-early-strength concrete must be used for the equivalent of a 10-ft. lane the entire length of the section, and for part of the other lane. Since the contractor included in his proposal the cost of handling traffic and maintaining the roadway in passable condition, the manner in which he produced high-early-strength concrete was one of his major problems.

High-Early-Strength Concrete—The department's specifications provide for two classes of high-early-strength concrete, that produced by a rich mixture of standard portland cement and that produced by a standard concrete mixture made with high-early-strength portland cement. Using the former method, a modulus of 550 lb. can be expected after three days' curing, while by the latter the department's experience indicates that the required strength can be secured in 24 hours under conditions prevailing throughout the working season.

The choice of method had a very important bearing on the traffic delays to be expected, since the distance between points of traffic control were subject to change with the scheme followed. For example, assume a daily production of 1,000 ft. of half-width concrete pavement construction and a three-day curing period, an average distance over which one-way traffic must be maintained would be about 4,000 ft. When the curing period is reduced to 24 hours, this distance varies from 2,000 to 1,500 ft. Traffic delays to be expected from the latter scheme would be less than half those calculated for the former.

The contractor elected to use the high-early-strength cement alternative, which would permit the opening of pavement sections within 24 hours. As practically one entire side of the highway was paved with this class of concrete, two-way traffic was maintained at all times except in the immediate vicinity of the mixer. Concrete more than 24 hours old was used as one traffic lane, whereas the subgrade accommodated traffic in an opposite direction.

In concreting the second half-width of the highway, sections of high-early-strength pavement alternated with those of standard concrete, the latter generally closed to traffic during the curing period of ten to fourteen days and traffic maintained in alternating files around them. The high-early-strength sections on this side permitted two-way traffic at such intervals as to insure its passage without exceeding the minimum delay period which had been set.

Procedure—Test beams were poured daily. Those from the high-early-strength sections were tested in 24 hours, and from the standard concrete sections at periods from ten to fourteen days. Twenty-four-hour results on the high-early-strength concrete sections gave values as high as 625 lb., and in every case during reasonable curing weather the required one-day strength was obtained. Tests on the normal cement concrete beams indicated acceptable strengths in ten days and in a few instances twelve and fourteen days.

Twenty-four-hour concrete was cured by the use of two thicknesses of saturated burlap placed as soon as the material had sufficiently hardened. The concrete was kept wet during the 24-hour period, after which the curing ceased and the pavement was thrown open to traffic. No curing agent was incorporated in the mix of high-early-strength concrete.

With the normal concrete a 2 per cent solution of calcium chloride was incorporated in the mix and the pavement kept wet for 24 hours, assisted by burlap covering, after which it was allowed to cure without further wetting until the test beams developed sufficient strength to permit its use by traffic.

Conclusion—Based on the studies conducted during the construction of this project, it appears probable that the method employed would have been economical even for traffic volumes considerably lower than those which actually applied in this case. The added expense of carrying vehicles over the right-of-way would no doubt have been justified for average daily traffic volumes *as low as 800 vehicles*. During the touring season, and on holidays or week ends, an average of 800 vehicles might well increase to 2,800 or 3,000 cars per day. Traffic of this density would require the same satisfactory treatment as given on this project.

The Pennsylvania Department of Highways conducts detailed traffic studies in connection with its major construction projects with the object of minimizing inconvenience and expense to the traveling public as a result thereof. It is the desire of the department that construction operations be carried on at minimum cost to the public considering such factors as cost of vehicle operation and traffic delays, following various schemes of construction, as well as the direct or contract costs of carrying on the work.

This work was carried on under the direction of H. E. Kloss, division engineer of the department, Pittsburgh, with R. E. Mackey assistant engineer in immediate charge. The contractor engaged in planning the various details and the execution of the work was J. I. Dick, of Scottsdale, Pa.

Benefits of Proposed River Cutoffs Determined by Model

Des Moines River at Ottumwa, Iowa, Reproduced in Hydraulic Laboratory of the University of Iowa

STUDIES on the determination of benefits of cutoffs in rivers have just been completed on a model of a section of the Des Moines River constructed in the hydraulic laboratory of the University of Iowa. This probably is the first attempt in the United States to determine in advance of actual field construction, by means of models, the benefits to be derived from straightening rivers. The success met with in this investigation on the effect of changes in channel alignment on flood heights was most gratifying.

Channel Conditions

The Des Moines River has in its course at Ottumwa two large bends, one situated in the upper or northwest part of the city, the other southeast of the city 1 mile below the lower end of the upper bend. The distance around the upper bend is 2.65 miles, while the distance directly across the bend is 1.21 miles. The distance around the lower bend is 2.38 miles, whereas it is only 0.91 mile directly across the neck of the bend. The drainage area above Ottumwa is 13,430 square miles.

The river channel varies from 450 to 600 ft. in width and from 14 to 16 ft. in depth. The banks are in most places practically vertical, the low-water channel averaging 500 ft. in width. Low-water flow in the main channel ranges from 2 to 6 ft. in depth, but the maximum floods cover the river valley approximately 6 ft. deep. The low-water channel is quite open, while willows usually are found on the slopes of the banks above low water. Rock outcrops at many places in the riverbed. The river valley, approximately 8,000 ft. wide, is mainly farming land with little timber, except along the banks of the stream. The slope of the river averages 1.6 ft. per mile.

When the Des Moines River is above the stage of 645 Memphis datum, part of the city of Ottumwa is inundated. The highest flood of record occurred on June 1, 1903, reaching a stage of 651 at the Market St. bridge and submerging a considerable portion of the business district of Ottumwa. Floods higher than 645 occur about once every three years.

The city of Ottumwa owns a power plant, situated at the lower end of the upper bend and supplied by an 80-ft. canal extending across the neck of the bend. Dams for impounding the water and diverting it into the canal have been constructed across the river on both sides of Turkey Island. To increase the capacity of its power plant the city is planning to enlarge the present canal to 200 ft. in width; for flood control it may ultimately be widened to 400 ft., and perhaps 600 ft. It is proposed to install a movable dam in the power canal that may be adjusted during flood stages to permit the free discharge of the floodwaters through the canal across the neck of the bend. The city officials believe that the construction of a cutoff across the lower bend in combination with the upper improvement would reduce appreciably the amount of damage caused by floods to Ottumwa. By the construction of these two cutoffs the river would be shortened 2.91 miles.

Since the major portion of the cost of the proposed improvements will be in the excavation of the cutoffs, the city officials determined to have a hydraulic model study made of the problem. It was decided to study combinations of various sizes of upper and lower cutoffs ranging from 200 to 600 ft. in width. Accordingly, an agreement was entered into with the University of Iowa and the U. S. Bureau of Public Roads whereby these agencies should supervise the construction of a model of the river and conduct the tests. The city of Ottumwa, through Horace A. Brown, superintendent of the waterworks and power plant, agreed to pay for the material and labor required to construct the model. The model was built in about five weeks; the testing consumed two weeks. The entire project was carried out under the general direction of S. H. McCrory, chief of the division of agricultural engineering, Bureau of Public Roads.

Construction of the Model

An area of the river valley 8,000 ft. wide by 33,600 ft. long and including the two bends was reproduced in the model, for which the topography was taken from the 1910 survey made by the Corps of Engineers, U. S.

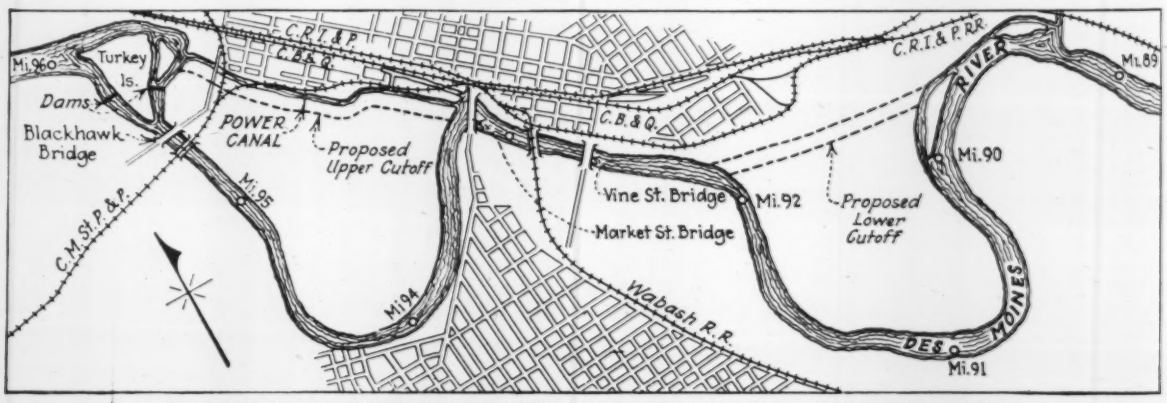


FIG. 1—PROPOSED CUTOFFS IN BENDS OF DES MOINES RIVER AT OTTUMWA, IOWA

FIG. 2—MODEL OF THE DES MOINES RIVER WITH TWO PROPOSED CUTOFFS ACROSS BENDS

Army. The total length of river channel covered was 9.32 miles. The model was made to a scale of 1:800 horizontal and 1:100 vertical. Although models of rivers have for several years been built in European hydraulic laboratories, this model is perhaps the first of its type to be constructed in America and one of the first to be constructed on a scale ratio of 8:1. This ratio was necessary in order to include the required area of the river valley in the 10x42-ft. steel flume of the laboratory and to read with sufficient accuracy the water surface elevations on the gage staffs.

Base lines 800 ft. apart were drawn on the topographic map and the elevations were taken from the map along each base line. Templets, 10 ft. long, were then cut representing the topography on each base line. These templets were placed 1 ft. apart in the flume. Additional auxiliary templets were used where needed to bring out the irregularities of the natural surface. For economy in construction, a shallow base of compacted sand was formed on which a 3-in. covering of concrete was placed, the concrete surface representing the surface of the ground. The proposed cutoffs were constructed as the work progressed, the concrete fillers for the cutoffs being made after the base of the model had been constructed. The cutoffs were made the same depth as the natural channel. The channel and adjacent parts of the model were made of 1:1 sawdust-cement motar.

The quantity of water flowing in the model was measured by means of a 90 deg. triangular weir located in the upstream end of the steel tank. Eleven staff gages were placed at various points along the model river channel for determining the elevations of the water surface. In addition to these staff gages, a point gage was installed at the Market St. bridge for obtaining an additional check on the water surface elevation. Fig. 2 shows the completed model, representing natural conditions except for the cutoffs.

Test Procedure

Since the city of Ottumwa was interested in possible relief from all floods over stage 645, tests on four stages of the river—namely, 645, 647.5, 649.5 and 651, Memphis datum—were carried out with each proposed channel improvement. The discharges for these stages as taken from a rating curve compiled from data given by the U. S. Geological Survey, and the corresponding scaled discharges for the model, are as follows:

Stage at Market St. Bridge	Actual Discharge, Sec.-Ft.	Discharge for Model, Sec.-Ft.
645.0	45,750	0.057
647.5	63,250	0.079
649.5	84,000	0.105
651.0	100,000	0.125

To reproduce flood conditions in the model exactly as they occur in nature, the high-water profile in the model for the maximum discharge must agree with that of the natural high water. Although the model had on a reduced scale the exact slope of the natural river, it was found that the concrete surface of the model did not offer sufficient resistance to the flowing water to yield the actual high-water profile of June 1, 1903, as given by the Corps of Engineers. Accordingly, the surface was roughened by first painting it with neat cement and then sprinkling a little coarse sand over the painted surface. Through this procedure the natural high-water surface was obtained in the model, as shown in the following table:

Distance in Miles Above Mouth of River	Actual High Water	High Water in Model	Remarks
96.5	655.6	655.2	
95.75	654.2	654.5	Above dam
95.70		652.0	
94.20	651.5	651.4	
93.15	651.0	650.7	Market St. Bridge
92.75	649.5	649.2	Vine St. Bridge
92.13	648.0	648.2	
91.00	646.5	645.9	
89.25	644.8	644.1	Mouth Sugar Creek
88.25	643.0	643.0	
87.75	642.3	642.8	

An adjustable gate was installed at the outlet of the model to hold the water to the level that occurs in nature at that point. The model was now in effect an exact reproduction of the natural river in so far as resistance to flow was concerned. The flood of June 1, 1903, as reproduced in the model, is shown in Figs. 3 and 4.

Tests were begun with the maximum stage, El. 651 at the Market St. bridge. After the flow had become steady and there appeared to be no change in the water level at any of the gage staffs, two sets of readings were taken of the elevation of the water surface at the various staffs and hook gages. For the stage of 649.5 the discharge was reduced to the computed model flow and the outlet adjusted so that the water surface at the staff at

FIG. 3—FLOOD JUNE 1, 1903, REPRODUCED ON MODEL WITHOUT CUTOFFS
Lower bend area practically all submerged.

the outlet read 1.5 ft. (in nature) lower than the high-water elevation for that point. After conditions had become steady, two sets of readings were taken on the staffs and hook gages. This procedure was repeated for stages of 647.5 and 645.

The following conclusions were drawn from the tests:

Effect of Cutoff Channel Across Upper Bend

1. The construction of a cutoff of any size across the upper bend would be ineffective in reducing flood stages at Market St. or at any point farther downstream.

2. Water levels above the dam would be reduced, in the highest floods, 1.1, 2.2, 2.8 ft. by the construction of a channel across the upper bend 200, 400 and 600 ft. wide, respectively. The effect of this cutoff on lower floods would be slightly greater.

3. The amount of reduction in stage decreases with the distance upstream from the dam; thus a cutoff channel 600 ft. wide would reduce flood stages only 1.3 ft. at a point 4,000 ft. above the dam.

4. In the highest floods the water levels immediately below the dam would be reduced about 1 ft., the extent of reduction increasing only slightly with increase in cross-section of cutoff channel and decrease in flood discharge.

5. Reduction in stage would decrease in amount with distance downstream from the dam, to a negligible reduction at the downstream end of the cutoff at Market St. bridge.

6. Diversion of the floodwater through the cutoff channel directly toward the opening under the Market St. bridge would greatly improve the current conditions approaching the bridge and would decrease velocities along the revetment on the river bank toward the bridge approach.

Effect of Cutoff Channel Across Lower Bend

1. The construction of a cutoff of any size across the lower bend would have maximum effect at the upstream end of the lower bend (mile 92.13), decreasing with distance upstream until an insignificant effect would be noted above the Ottumwa dam.

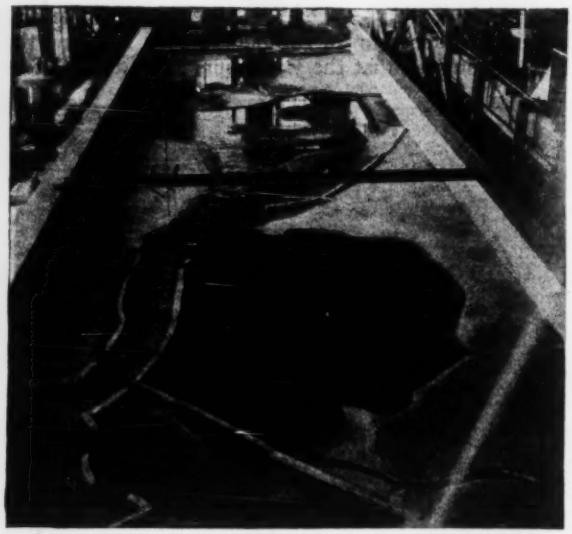


FIG. 4—THE JUNE 1, 1903, FLOOD WITH CUTOFFS OPERATING—MATERIALLY REDUCED GAGE HEIGHTS

2. In the highest flood, water levels above the lower cutoff channel (mile 92.13) would be reduced 2.8, 3.3, 3.7 ft. by the construction of a channel across the lower bend 200, 400 and 600 ft. wide, respectively. The effectiveness of this cutoff channel would be relatively greater during lower floods.

3. The reduction in flood stages at Market St. bridge would be less than at mile 92.13. During the highest floods the stage at Market St. would be reduced about 0.9 ft. At this point there is no significant difference as between the effects of cutoffs 200, 400 or 600 ft. wide.

Effect of Cutoff Channels Across Both Bends

1. The construction of a cutoff channel of any size across the upper bend would not alter conditions produced by the lower cutoff channel, at points downstream from Market St. bridge.

2. The construction of a cutoff channel across the upper bend would more readily allow the transmission of the benefit from the lower cutoff to points upstream from Market St. bridge, even to points above the dam. Water levels above the dam at highest flood, after the construction of the upper cutoff channel, would be 0.8 ft. lower with the excavation of the lower cutoff than without it.

3. As compared with a width of 200 ft., a lower cutoff width of more than 200 ft. would give little increased benefit along the river above Vine St. bridge.

4. Summarizing, a 400-ft. channel across the lower bend, combined with a 200-ft. waterway across the upper bend, would decrease water levels as follows, in high and low floods:

Location	At Mile	Decrease in Flood Level: Flood Similar to 1903	Decrease in Flood Level: Flood of 50,000 Sec.-Ft
Above lower bend	92.13	3.3	4.5
Vine St.	92.75	1.6	1.6
Market St.	93.15	1.0	0.9
Below dam	95.70	1.3	2.0
Above dam	95.75	1.7	2.3

5. If the upper channel were further widened to 400 ft., the reduction of flood heights would be:

Location	At Mile	Decrease in Flood Level: Flood Similar to 1903	Decrease in Flood Level: Flood of 50,000 Sec.-Ft.
Above lower bend	92.13	3.3	4.5
Vine St.	92.75	1.5	1.6
Market St.	93.15	1.0	0.9
Below dam	95.70	1.9	2.5
Above dam	95.75	3.2	3.5

Effect of Channel Enlargement Near Market Street

1. Widening the channel at Market St. bridge would be effective in producing better current conditions, if the widening were done on the south side, and considerable fill may be placed on the north bank near the bridge with no detrimental effect whatever. However, enlargement of the Market St. opening would not result in significant lowering of flood stages at or above that point.

2. Widening the river channel 200 ft. from Market St. bridge to mile 92.13, just above the lower bend, would during the highest floods reduce river stages about an additional foot from Market St. to a point just above the dam, provided the lower cutoff had been excavated to full width and a 200-ft. cutoff channel had been constructed across the upper bend. The benefit would be less for the lower floods.

The model studies indicate that the following program of channel improvements would yield the most benefit in connection with the discharge of floods through Ottumwa:

1. Construct across the upper bend a floodway which need not exceed 400 ft. in width.

2. Construct across the lower bend a floodway which need not exceed 400 ft. in width.

3. All levees on the south bank, between Market St. and the entrance to the lower cutoff, should be moved back to at least 200 ft. from the bank of the channel.

Second Great Power Development on Saguenay River Begun at Chute-a-Caron

Part of the Fall Between Tailwater of the Plant at Isle Maligne and Tidewater at Chicoutimi to Be Developed at a Dam at Chute-a-Caron as the First Stage of Larger Development—Complete Development in Second Stage Will Be in Plant on Shipshaw River—Large Volume of Water in River Complicates Undertaking

FIG. 1—CHUTE-A-CARON PROJECT, PART OF THE DAM AND THE CONSTRUCTION PLANT

ALL the great power resources of the Saguenay River in Quebec are concentrated in the falls and rapids which occur in the 32 miles of river between the outlet of Lake St. John and tidewater above the town of Chicoutimi. Below Chicoutimi the river runs in a deep submerged gorge extending out into the St. Lawrence River. The total fall from Lake St. John to tidewater is about 300 ft., and, as the river flow is high, ranging normally from 200,000 sec.-ft. in flood to a minimum of 28,000 sec.-ft., the power possibilities of the upper section of the river have long been appreciated, but the magnitude of the work of damming the river to control any part of it has, until recent years, kept any one from attempting to develop power there. Consequently the earlier power developments in the river valley were confined to the more easily controlled tributary rivers which fall steeply into the Saguenay below Lake St. John. This power is used by lumber and pulp and paper companies which have located in the valley.

After the War the pulp and paper business of the Lake St. John region had expanded to the point where much more power was needed, and in addition developments in high-tension transmission of electricity made it more feasible to transmit power to Quebec, some 140 miles. Consequently in 1923 the Quebec Development Company, a subsidiary of the Duke-Price interests, began the development of power at the outlet of Lake St. John in a power house across the Grande Décharge, the main outlet of Lake St. John, at Isle Maligne, about 7 miles below the lake. An earth dike and seven concrete spillways were built to close off the Petite Décharge and other channels formed in raising the level of the lake by the dam at the Grande Décharge. Descriptions of this work were published in *Engineering News-Record*, Oct. 16, 1924, p. 616, Oct. 23, p. 662, and Oct. 30, p. 702.

The Isle Maligne plant develops a head varying from 110 to 120 ft. and now has installed and in operation eleven of twelve possible units of 45,000-hp. capacity each. It is developing 500,000 hp., part of which goes to Quebec over a 187,000-volt transmission line and the remainder is consumed in local pulp and paper interests and at the plant of Aluminium, Ltd., at Arvida, farther down the river, for the electrolytic production of aluminum.

The Lake St. John region, with its great resources of cheap electric power and its easy access to the ocean trade routes of the world by way of the St. Lawrence and Saguenay rivers, holds unusual attractions for the electrolytic production of aluminum. These conditions led the Aluminum Company of America to acquire a large tract of land between Chicoutimi and Jonquiere, and to begin, about the time the Isle Maligne plant was

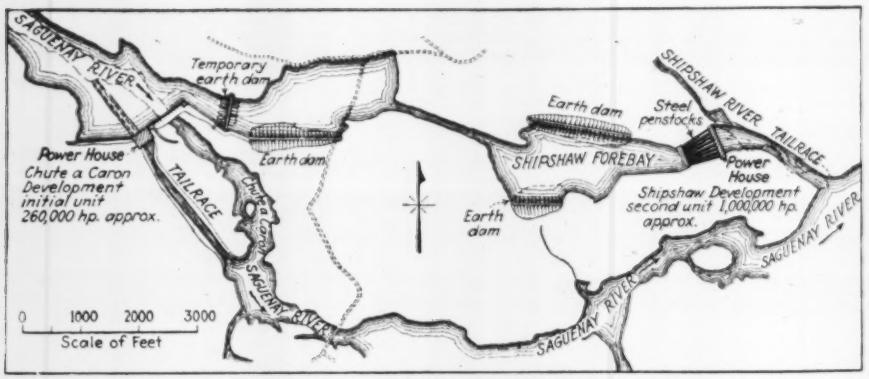


FIG. 2—PROJECTED DEVELOPMENT OF REMAINING POWER SITES ON THE SAGUENAY RIVER

The Chute-a-Caron development is the initial stage. When the Shipshaw development is completed the Chute-a-Caron plant will be used to generate secondary power.

built, the laying out of a town on the most improved methods of town planning and the construction of a plant for the production of aluminum. That plant has now been in operation for three years and as its power demand has reached a point where it uses 100,000 hp. continuously 365 days a year, and as it will use more in the near future, the company began the construction of a second power project on the Saguenay River in 1927, at Chute-a-Caron, near Jonquiere, Quebec.

Chute-a-Caron and Shipshaw Projects

Development of the power possibilities of the Saguenay River between tailwater level of the Isle Maligne plant and tidewater near Chicoutimi can be made in one step, but on account of the magnitude of that undertaking and the urgent demand for power, the development is being carried on in two stages. The first stage, the Chute-a-Caron project, is to be brought into service in July, 1931. The second, the Shipshaw project, is to be brought into service at some later date. When the Shipshaw development is completed, the Chute-a-Caron plant will be used as a stand-by plant and for the production of secondary power during periods of excess flow in the river.

The first stage, the Chute-a-Caron project, consists of a concrete dam 200 ft. high across the river and a power house containing four hydroelectric units of 65,000 hp. each and developing 151 ft. of the remaining head of 205 ft. between the head of the Isle Maligne plant and tidewater. At maximum head and full gate the turbines will develop 75,000 hp.

The second stage is an over-all development using the Chute-a-Caron dam as a diversion dam. By means of a channel along a neck of land on the easterly side of the valley the usable flow of the river is diverted to a power house located near the mouth of Shipshaw River, a tributary of the Saguenay. Below this power house, about 1,000,000 yd. of earth and rock will be dredged from the river to bring the tailwater elevation of the power house practically to tidewater elevation. This project is known as the Shipshaw development. Ultimately it will produce about 1,000,000 hp. of hydroelectric energy. Its location and that of the Chute-a-Caron project are shown in Fig. 2. Very large quantities

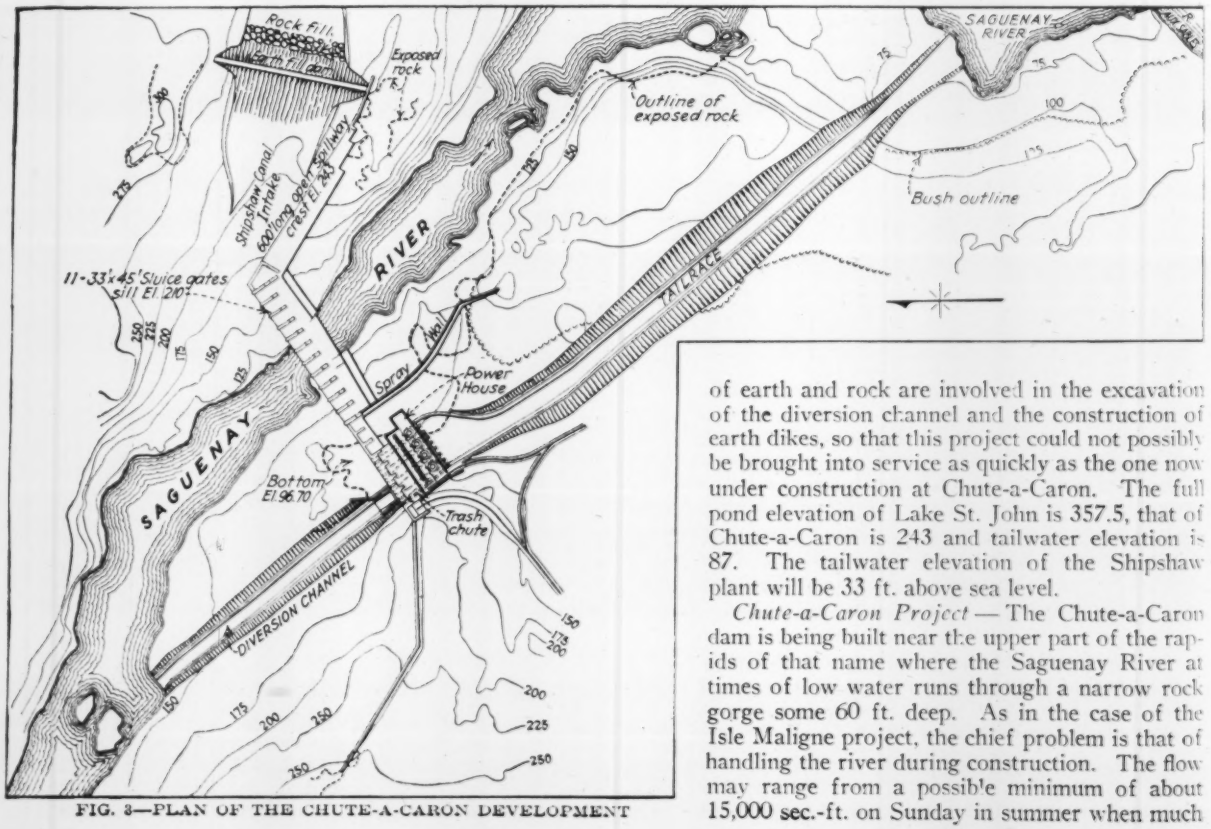


FIG. 3—PLAN OF THE CHUTE-A-CARON DEVELOPMENT

of earth and rock are involved in the excavation of the diversion channel and the construction of earth dikes, so that this project could not possibly be brought into service as quickly as the one now under construction at Chute-a-Caron. The full pond elevation of Lake St. John is 357.5, that of Chute-a-Caron is 243 and tailwater elevation is 87. The tailwater elevation of the Shipshaw plant will be 33 ft. above sea level.

Chute-a-Caron Project — The Chute-a-Caron dam is being built near the upper part of the rapids of that name where the Saguenay River at times of low water runs through a narrow rock gorge some 60 ft. deep. As in the case of the Isle Maligne project, the chief problem is that of handling the river during construction. The flow may range from a possible minimum of about 15,000 sec.-ft. on Sunday in summer when much

of the Isle Maligne plant is shut down, to a normal maximum of 200,000 sec.-ft. in the spring, with a possible fall flood of 100,000 sec.-ft. to be taken into consideration. The design of the project and the construction program were worked out chiefly to meet this condition. Details of the project are shown in Fig. 3. As the existing river channel is too limited to be encroached upon even at times of low flow, the first operation was the construction of a diversion channel across the bend in the river at the dam site. Work on this was begun in July, 1927, but active construction did not get under way until about January, 1928. At that time much of the old excavating equipment which had been brought down from the Isle Maligne plant was scrapped and new equipment substituted, including a 4-yd. electric shovel, which could turn out about three times as much work as the old 2-yd. steam-operated shovels.

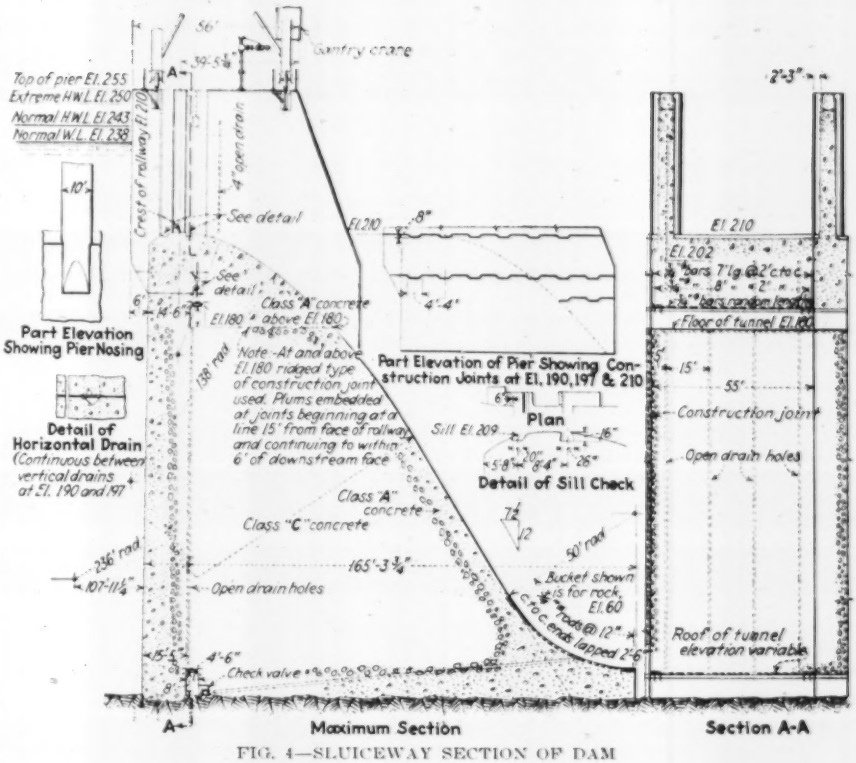

Gantry crane
Top of pier El. 255
Extreme H.W.L. El. 250
Normal H.W.L. El. 243
Normal W.L. El. 238
Crest of railway El. 210
4" open drain
See detail
Class "A" concrete
El. 180 & above El. 180
Part Elevation Showing Pier Nosing
Detail of Horizontal Drain
(Continuous between vertical drains at Sl. 190 and 197
Note -At and above El. 180 ridged type of construction joint used. Plums embedded at joints beginning at a line 15' from face of railway and continuing to within 6' of downstream face
Part Elevation of Pier Showing Construction Joints at El. 190, 197 & 210
Plan
Sill El. 209
Detail of Sill Check
Class "A" concrete
Class "C" concrete
Open drain holes
Bucket shown is for rock, El. 60
Roof El. 12"
Roof of tunnel elevation variable
Check valve
El. 210
El. 202
Floor of tunnel El. 180
Construction joint
Open drain holes
Maximum Section
Section A-A

FIG. 4—SLUICEWAY SECTION OF DAM

The excavation program then laid out called for 70,000 cu.yd. (mostly rock) per month from the diversion channel and the power-house site, which is in an enlargement of the diversion channel, just below the dam. When the excavation work reached its peak, the monthly yardage was up to 120,000 cu.yd. and a total of from 2,000 to 2,600 lin.ft. of holes was drilled each day. Before the spring floods came the major portion of the upper end of the channel had been excavated and a cofferdam built across it to permit the work to be carried on downstream during the high-water period.

In addition to the diversion channel work, the late summer and fall of 1928 were used for building permanent camps and construction plant, grading and laying the several miles of standard-gage railroad required to reach both ends of the dam, excavation for those parts of the dam foundations which were above high water on both sides of the river, and placing concrete in parts of these extremities of the dam. Construction of the railroad involved the building of a bridge 404 ft. long over the river below the rapids.

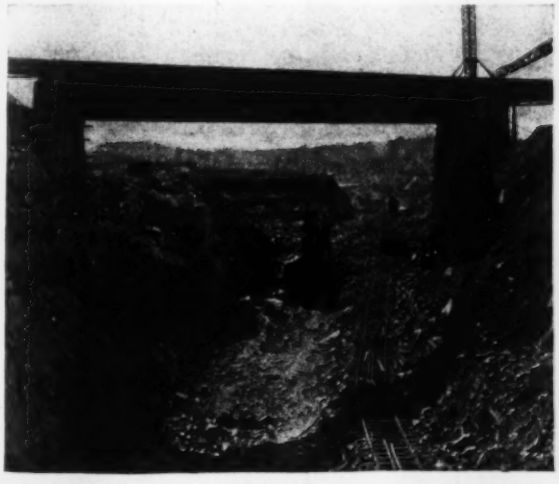


FIG. 5—RIVER DIVERSION CHANNEL AND TAILRACE

The present construction program calls for completion of the project in July, 1931. This year the section of the dam east of the main channel will be completed, also the power-house section except for the draft tube of one unit which is in the diversion channel, and the extreme western end of the dam. The diversion channel will be excavated and lined in those points below the power house where the flow level comes above the rock line and where velocities will be unusually high during the period in which the diversion channel is in use. At the east end of the dam the channel for the upper end of the Shipshaw power canal intake will be excavated to full section and then dammed off so that work in that channel can be carried on in the dry after the reservoir back of the Chute-a-Caron dam is full. In addition, preparations are being made for closing off the main channel of the river, diverting its whole flow through the dam as soon as the fall floods are passed.

River Diversion—Above the point where the diversion channel leaves the main river there are, at times of low water, two small islands of rock at the west side of the main channel. These are to be connected with the west bank by a cofferdam, and another cofferdam built last year to protect the upper end of the diversion channel is to be extended upstream to the outer island. These two cofferdams will entirely close off the upper end of the diversion channel for its final deepening. While this work is going on there are to be built upon the outer island two blocks of concrete having base dimensions about 40x40 ft. and a height of about 100 ft. As soon as the diversion channel is ready to take water, in the late fall of 1930, these blocks are to be tipped over into the main channel to effect as complete closing of the

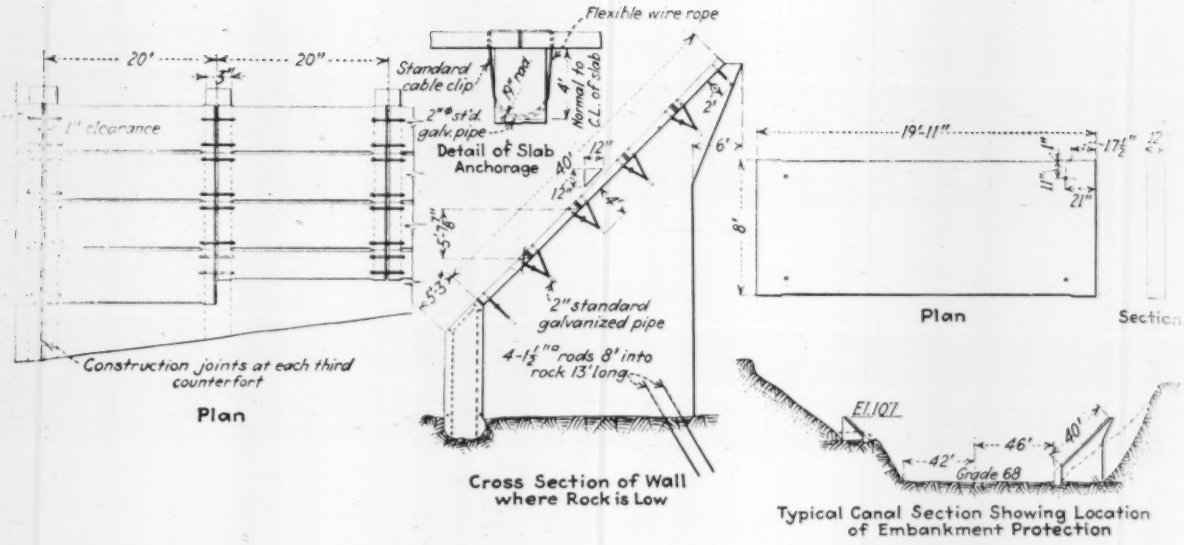


FIG. 6—EMBANKMENT PROTECTION FOR THE TAILRACE

channel as possible. To that end, the channel has been cross-sectioned as accurately as the swift current will permit and the channel side of the obelisks, as the large concrete blocks are called by the engineers of the power company, will be given a similar profile. Each obelisk is to be made long enough so that its top will reach an abutment of concrete to be built out from the east bank a little downstream of its position.

It is hoped that the obelisks will divert sufficient water from the main channel to permit building one or more sections of the dam adjoining the main channel before the fall floods. After the fall floods have passed, the dam formed by the obelisks will be made as watertight as possible, a supplementary cofferdam will be built below it to catch leakage, and then the deep mid-channel section of the river will be unwatered and the work of completing that section of the dam to full height, a race against time and cold weather, will be begun. About

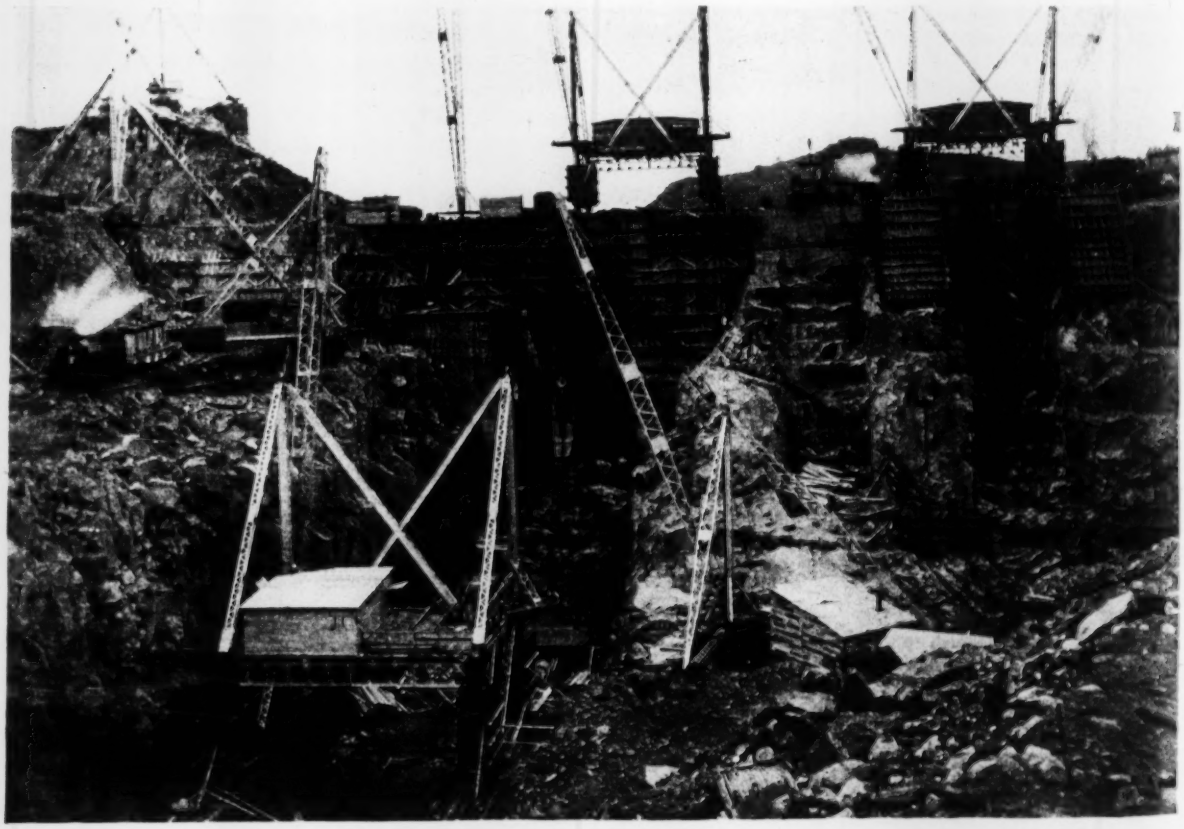


FIG. 7—POWER-HOUSE SITE AND DIVERSION SLUICE

The picture is taken looking upstream. The river diversion sluice is at the left center. Excavation for two intake foundations at the right.

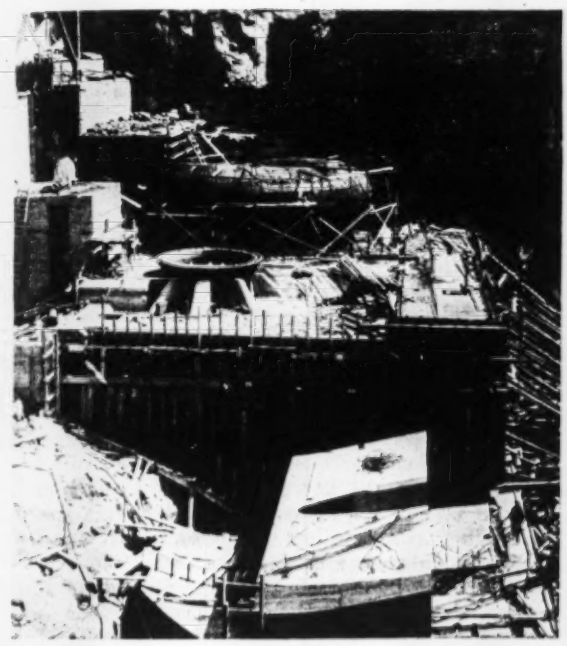


FIG. 8—FOUNDATIONS OF THREE OF THE UNITS IN THE POWER HOUSE

150,000 yd. of concrete will have to be placed between the date of tipping the obelisks and April 1, 1931, when the spring flood comes down from the lake.

Diversion Sluice—The maximum discharge to be handled through the diversion channel has been estimated to be 50,000 sec.-ft., and as it is desirable that the sluiceways through the dam for diversion purposes should not occupy more than the area under the penstocks for one unit, studies were made on a model built to a scale of 1 to 18 set up on the spillway of the dam at Isle Maligne. This model is shown in Fig. 10. It was found from the tests that 50,000 sec.-ft. could be carried through two sluiceways under the penstocks for one unit without submerging the intake to the sluiceway and without developing destructive erosion in the tailrace channel.

Tailrace Channel—Below the dam the diversion channel will serve as the tailrace from the power house. Its upper end is in solid rock, but farther downstream it is partly in rock and partly in glacial material, and as velocities will be as high as 30 ft. per second during the river diversion period, a substantial concrete lining for that section is being provided. The type of lining to be used is shown in Fig. 6. It consists of concrete toe-walls cast in place and a sloping face of precast steel-reinforced concrete blocks supported on concrete ribs, which also are cast in place. The precast blocks are being cast in a yard convenient to the mixing plant, where pouring is done intermittently when the concrete demand on the dam is slack. In this manner the cost of concrete for most of the lining is being kept at $6 to $8 a yard, as compared with $15 for concrete cast in place. The blocks are to be lashed to the supporting ribs with steel cables as a temporary expedient during the time the channel is used for river diversion purposes. Subsequently, as velocities in the channel will never exceed 8 ft. per second, the weight of the blocks (12 tons) will be sufficient to hold them in place.

Details of the Dam—The dam is shown in plan and section in Figs. 4 and 9. Briefly, it consists of a long gravity bulkhead section on the west bank extending out to a bulkhead section containing the penstocks and the power house. Beyond this, in the river channel, is the main spillway section capped by Stoney gates to control the pond level, and on the east bank is a long overflow section which will eventually form one side of the intake to the Shipshaw power canal and act as a spillway for surges which might otherwise go down that channel and cause trouble at the lower end. The dam is designed to pass a maximum flood of 600,000 sec.-ft.

Three of the four hydro-electric units in the power house are being built at the present time, and the penstocks for the fourth unit are also being built, but as the diversion sluice through the dam discharges into the space to be occupied by the draft tube of the fourth unit, work on it will not be started until after the diversion sluice is closed. The sluice is controlled at its upper end by two steel Stoney gates When there is no further use for the sluiceways, these gates will be closed and the sluiceways filled with concrete.

Unlike most dams in cold climates, no housing is provided over the intake gate controls of this dam. Instead, the intakes are so deeply submerged that the operating mechanism may be set in recesses below the deck of the dam. These recesses in the dam are heated by warm air supplied through ducts from the generator room. This scheme works satisfactorily at the Isle Maligne plant. Electric heaters are to be placed in the slots of the Stoney gates on the dam and if necessary the gates

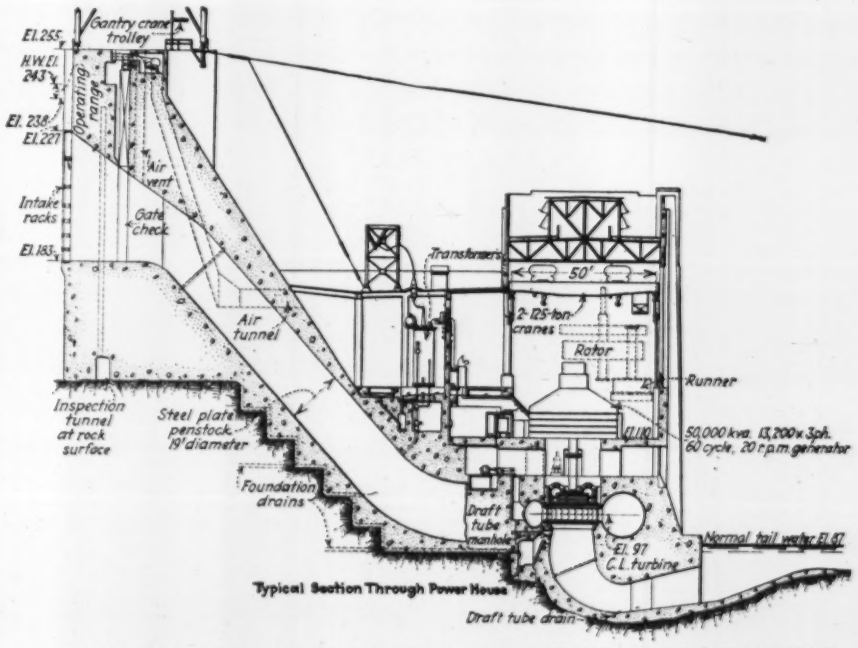


FIG. 9—CROSS-SECTION THROUGH POWER HOUSE AND INTAKE SECTION OF DAM

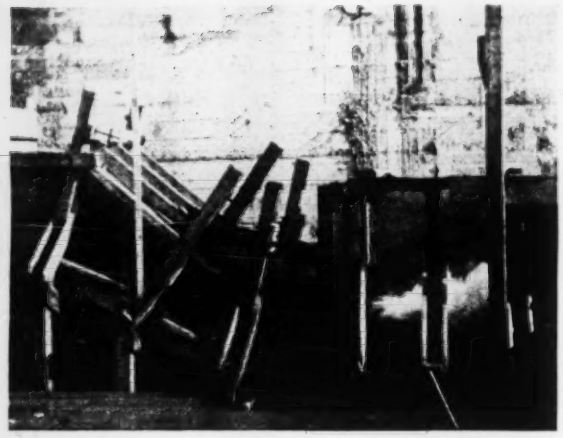


FIG. 10—MODEL USED TO DESIGN DIVERSION SLUICE

themselves will be bulkheaded and heated. Air will be supplied to the dam for discharging into the water above the gates to prevent ice freezing in solid masses against them.

Both the spillway gates and the power-house gates will be operated by a gantry crane on the deck of the dam.

Because of the size and depth of the pond above the dam and the fact that Lake St. John freezes over early and remains covered with ice and snow until the ice rots in the spring, no trouble is expected with either frazil or floating ice. Experience at the Isle Maligne plant also indicates that what little trash accumulates on the deeply submerged racks can be handled manually with no difficulty.

Foundation Conditions—The dam throughout its entire length is founded upon a hard igneous rock having few seams carrying water, but grouting is to be resorted to to check any possible underflow. Grouting holes have been sunk into the underlying rock at intervals of 10 ft. along the line of the lower inspection gallery through the dam. This tunnel, unlike most such inspection galleries, is formed directly on the underlying rock, so that any underflow along the plane between the rock and concrete will show up in the inspection galleries. Grouting of the underlying rock will be undertaken as soon as the dam is completed.

Checking Seepage—Extending upward through the dam from the top of the lower inspection galleries at 20-ft. intervals are drain holes 18 in. in diameter. They are designed to collect and discharge to the galleries any seepage through construction joints or cracks in the dam. Special provisions have been made in the construction of the dam to insure this water reaching the drain holes. The vertical construction joints in the dam are closed with 6x6-in. wooden strips set with their diagonal plane in the joint plane, and horizontal construction joints are stopped by 2x8-in. planks set on edge in the fresh concrete near the upstream face of the dam. As each day's pour of concrete is completed, the top of the concrete, which is very stiff, is given a pitch toward a small ditch formed in the concrete roughly parallel to the upstream face of the dam and sloping toward the vertical drain shafts. Before the following pour is made a board is laid over each of these ditches and covered with loose rock taken from the concrete. This arrangement not only provides a definite channel by which water that finds its way into the construction joints may reach the drain wells but also avoids the formation of definite planes of weakness.

Concrete—Unusual methods of mixing, testing and placing concrete are being employed. They were described in *Engineering News-Record*, Oct. 24, 1929, p. 640. The mix which is specified is designed to be very stiff, so stiff, in fact, that electric vibrators are being used to get the concrete placed properly in the forms.

Construction Plant—The construction plant is typical of most large construction jobs, except that electrically driven equipment is used wherever possible. This includes shovels, derricks, travelers and hoist engines, as well as equipment for the more ordinary uses, such as motor-driven crushers, mixers and compressors. Travel-

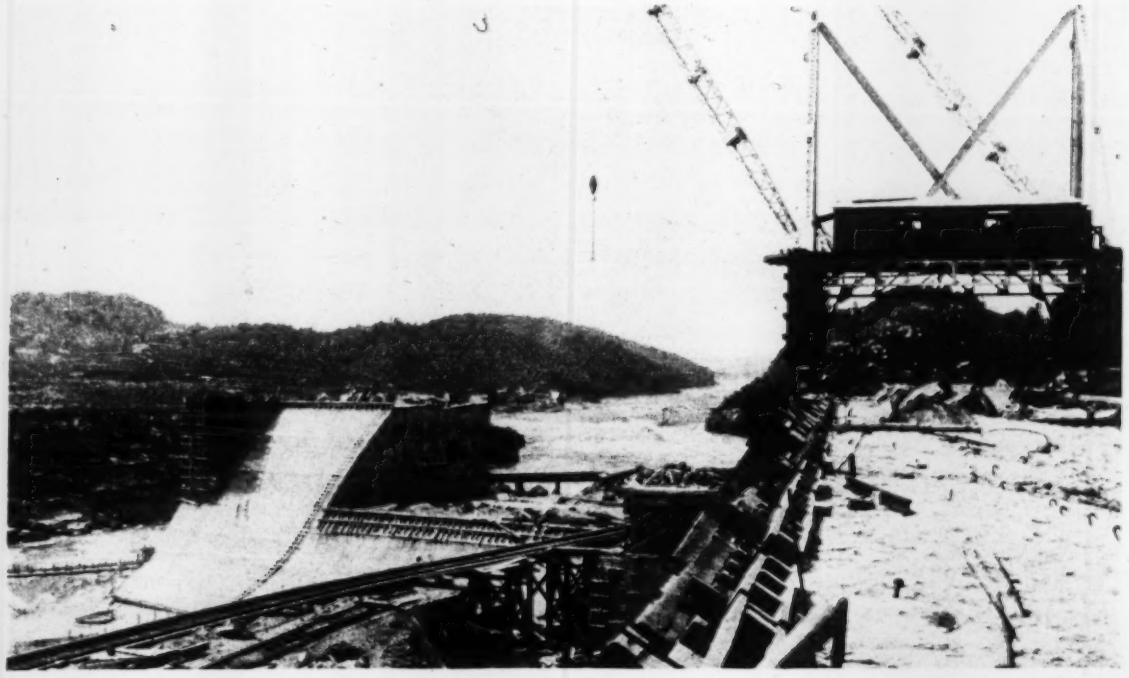


FIG. 11—EAST END OF THE MAIN DAM LOOKING UPSTREAM ALONG THE FACE OF THE OPEN SPILLWAY

ers and stiff-leg and guy derricks are used for handling all work around the dam and power house. Much of this equipment was used in the construction of the Isle Maligne plant.

The location of the rock-crushing plant and mixing plants is shown in Fig. 1. They are so placed that the rock can be delivered by gravity from a trestle running over the plant from the high-level railway along the side of the hill and cement can be delivered to the cement storehouse (in bulk) at another level. Concrete is taken away by rail at a still lower level. Belt conveyors are used chiefly for handling the cement and aggregates. All concrete is delivered to the job in buckets, transported on standard-gage railway cars.

On account of the large amount of rock to be excavated, much care was taken in equipping the drill-sharpening shop and the compressor plant. Constant temperature furnaces are used for drill sharpening despite the claim of the men that they can turn out more drills with the old-fashioned uncontrolled heaters. As a result, drill breakages have been kept very low and the wear has been quite uniform. Coolers are used at the compressor plant to reduce the moisture content of the compressed air during freezing weather and consequently very little trouble has been experienced with frozen air lines.

Labor—The labor is largely French Canadian from neighboring towns and countrysides, and consequently camp problems are unimportant. The work is being carried on in one ten-hour shift, except when a large continuous pour of concrete is being made. During the time when the work on the rock excavation was at its peak, two ten-hour shifts were employed.

Personnel—The plant is being built by Alcoa Power Company. H. W. Small was chief engineer until Aug. 1. The present chief engineer is C. P. Dunn. The consulting engineers on the work are James W. Rickey, J. P. Growdon, T. J. Bostwick and W. S. Lee. I. G. Calderwood is general superintendent of construction, Ross White is assistant superintendent of construction and J. K. Black is resident engineer.

Stream-Pollution Control in Ohio

The Engineering Experiment Station of Ohio State University, in co-operation with the Ohio Department of Health, is investigating stream-pollution control. F. H. Waring, chief engineer of the Ohio Department of Health, and Prof. John C. Prior, of the department of civil engineering, Ohio State University, have been assigned as investigators on the project. This investigation has a threefold purpose, and has been outlined as follows:

1. To present the existing status of stream pollution.
2. To show what corrective measures are now in effect.
3. To forecast needed measures for reasonable improvement in the stream-pollution situation.

It has also been planned to take up the investigation of stream pollution from three different standpoints:

1. Effect of pollution upon public water supplies derived from surface sources.
2. Preventing nuisances to the public health or comfort as a result of stream pollution.
3. Conservation of Ohio streams to effect greater public benefits.

Further plans of the investigation include the consideration of pollution effects in the order of their importance, such as municipal sewage, industrial wastes, and natural or semi-natural effects.

State Denies Permission to Build San Gabriel Dam as Proposed

Board Advises State Engineer That Site Is Intricately Faulted and Unsafe for 500-Ft. Concrete Dam—Conservative Rockfill Suggested

THE application of the Los Angeles County Flood-Control District for permission to build the San Gabriel dam was disapproved by State Engineer Edward Hyatt on Nov. 26, acting under authority of the new California dam control act. This refusal of permission to erect the 500-ft. concrete dam at the "Forks site" on the San Gabriel River about 30 miles northeast of Los Angeles was based on an adverse report made by a consulting board appointed by the state engineer to pass upon the safety of the proposed dam foundations. This board (*Engineering News-Record*, Nov 7, 1929, p. 742), consisting of C. P. Berkey, George Louderback, I. A. Williams, geologists, and G. A. Elliott, M. C. Hinderlider and J. L. Savage, engineers, rendered an opinion that the proposed dam "cannot be constructed without creating a menace to life and property."

As a "supplementary suggestion" the board found that an earth- and rock-fill dam of conservative design would provide a structure best suited to resist earth movement and could be built safely at the site. As affects this suggestion, the decision regarding the high concrete dam is without prejudice to the right of the county to file any new applications for this site. Any such application, of course, would require an independent review.

The essential findings of the board appointed by the state engineer are given in the following:

Findings of the State Engineer's Board

Rock Formation and Conditions—The rocks at the site are ancient crystalline types, including granitic and dioritic gneisses and occasional schists cut by a variety of igneous intrusions including granite, diorite, diabase and other types. The result is a crystalline complex of involved history whose character and quality would be eminently satisfactory for any engineering structure if the rocks had undergone no deformation and decay.

Cut through in every direction by faults, slips and crush zones, the rock at the site has been separated into blocks of various sizes and shapes, mostly of comparatively small size. The entire site and immediate vicinity show this broken condition and, in addition, the individual blocks are broken and fractured so that there are no extensive bodies of solid rock.

Among the few zones of major movement extending through the San Gabriel Mountains is one that takes a general west course determining the alignment of the two branches of the San Gabriel River and another that runs apparently north and south followed by the stream below the forks. The dam site at the forks of the river is therefore in the junction area of the two fault zones.

As a result of faulting and crushing, the upper slopes of the canyon sides are extensively disintegrated and decayed. "The crushed and pulverized rock along the fault breaks is often transformed into clay gouge. Some of it is so soft that when moist it can be molded with the hands." Weathering also has resulted from these movements, and "along the more fractured zones, decay extends as deep as explorations have gone." Landslides

of varying ages are common along the canyon slope, indicating the slumping of blocks or groups of blocks on slip planes when weakened by stream undercutting or lubrication due to water seepage from weathering. Where harder rock occurs, the individual blocks are larger and slips are less numerous. This fact accounts for the better appearance of the east abutment, although the principles represented are the same. Even the floor of the canyon contains a badly broken zone, and the same general condition extends beyond the site, making it impossible "to find materially better conditions at any other location in the immediate vicinity of the forks."

Both abutments show the same intricate combination of faulting and crushing and give no reason to expect better conditions with further excavation. In portions of the drill holes along the canyon bottom, drill holes produced only a small percentage of core because of the poor condition of the rock.

Foundation Stresses—Maximum compressive stresses as shown by the plans are 41.7 tons per square foot at the downstream toe with reservoir full. By slight modification of the section this could be reduced to 40 tons, which is considered generally accepted safe practice. Such stresses are based on the assumption that the resistance of the foundation rock is uniform at all points, but if substantial areas of the foundation are weakened by fault zones or other defects the more unyielding portions of these rocks will receive more than their proportion of load.

Conclusion—"The fundamental requirement for a high concrete gravity dam is that it be built on firm, sound rock of uniform compressibility. This condition does not exist at the San Gabriel site. It is the unanimous opinion of this board that the foundation conditions are such that the proposed dam cannot be constructed without creating a menace to life and property."

Supplementary Suggestions—Supplementary to this determination the board concluded that foundation and other conditions are suitable for a properly built flexible dam of conservative proportions. A structure of the earth- and rock-fill type would be best adapted to stand earthquake shocks or earth movement. Unless further exploration shows materially different conditions, such a structure placed by the hydraulic method with concrete core wall can safely be constructed at this site. Unusual precautions in the design would be necessary, however, such as limited height, adequate cutoff, large freeboard, flat slopes and an ample downstream toe blanket. A specific recommendation is that the slopes provide a percolation distance (length of water travel) along the base of the dam equal to at least eight times the maximum depth of water. A reinforced-concrete core wall should be supplemented by sluiced material extending to bedrock in an open cut on both sides of the wall, to constitute an impervious section even though the concrete wall was breached.

The San Gabriel dam project has gone through a long period of controversies since the voting of the flood-control bond issue in 1924, which included $25,000,000 for this structure (*Engineering News-Record*, June 26, 1924, p. 1088). The two requirements of the dam, flood-control and irrigation, brought into action parties having conflicting interest, and after several court hearings on applications for injunctions it was decided to adopt plans for a high dam to store 240,000 acre-ft., in preference to the proposal of one of the parties to build a low dam storing only two-thirds as much. (*Engineering News-Record*, Oct. 6, 1927, p. 563.) The design finally adopted was described in some detail in our issue of Nov. 15, 1928, p. 733. The height selected was about 500 ft., making it about 135 ft. higher than any existing dam and 100 ft. higher than the Owyhee dam.

The contract was awarded in December, 1928, to Fisher, Ross, McDonald & Kahn, Inc., of Los Angeles, and excavation at the site proceeded until Sept. 16 last, when an extensive rock slide occurred at the west abutment. (*Engineering News-Record*, Sept. 26, 1929, p. 509.) Further construction work was stopped immediately, and the district retained a board of engineers and geologists who examined the site and on Oct. 14 reported adversely; a comprehensive review of the findings of this board was published in *Engineering News-Record*, Oct. 31, 1929, p. 699. Directly following this report, the state engineer, acting by the authority of the new dam control law, engaged the men named in the first paragraph to report to him on the safety of the dam foundations.

The fundamental conclusions of this board, upon which the state engineer has based his action, are generally similar to those of the board retained by the district, in that both find the foundation conditions at the site unsafe for a concrete dam of the height proposed.

The law requiring the approval by the state engineer of the design and location of all dams built in the state was passed following the failure of the St. Francis dam and some months after work on the San Gabriel dam had been started.

Flint, Mich., Day Labor Records

Since 1924 the record daily runs of the different construction crews under H. C. McClure, city engineer of Flint, Mich., have been carefully recorded. This last season's weather was favorable toward breaking many records. The following indicate daily runs of the pavement construction gangs in 1924 and 1929 compared, as reported by G. M. Osborne, assistant city engineer: excavation, 630 cu.yd. in 1924, was increased to 903 cu.yd. in 1929; fine grade from 2,981 to 3,800 sq.yd.; curb and gutter from 680 to 1,105 lin.ft.; concrete foundation from 1,301 to 2,152 sq.yd.; asphalt surface from 2,016 to 4,738 sq.yd.

In sanitary sewer construction a maximum day's run of ten hours in 1929 was 1,575 lin.ft. and for a week of 60 hours, 6,402 lin.ft. For sidewalk construction a maximum of 5,550 sq.ft. was laid on one day, and in July two gangs laid 10.2 miles.

Flint is one city that maintains its dirt streets. All unpaved streets in the city limits were graded four times or more if traffic warranted. All gravel roads are gone over by maintenance crews every two weeks to keep them in good condition. Bad places are patched, culverts are cleaned and some new ones placed, rubbish and stone are picked up and weeds are cut at regular intervals.

More than 21,000 tons of garbage was collected and fed to hogs during the year ended Aug. 31. The number of animals varies from 3,500 to 5,000, depending on the seasonal variation of garbage collected. A new feeding platform building has been installed to permit feeding under cover, which makes for better control of odors and the disposal of refuse.

House connections were made on 70 streets for water and sewer pipes and exceed in number those of any previous year. A total of 1,100 connections was made at a cost of $51,000. This work was done by contract.

Emergency Restoration of Manila Water Supply

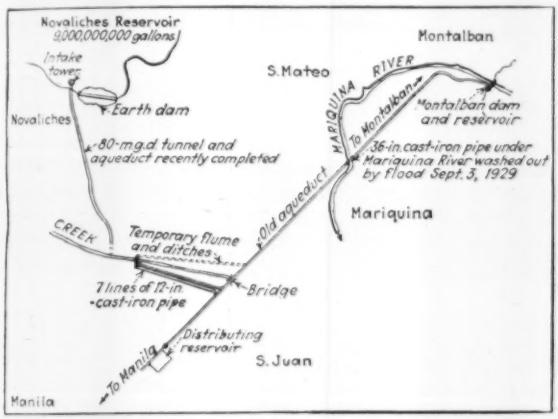
New Source Made Available by Ditches and Flumes, Then by Multiple Lines of Cast-Iron Pipe After Flood Breaks Siphon

By A. Gideon

Manager and Chief Engineer, Metropolitan Water District, Manila, P. I.

RECORD-BREAKING high water at the time of the typhoon that passed very close to Manila, Philippine Islands, Sept. 3-4, 1929, washed out a river undercrossing in the conduit from the source of water supply then in use. The emergency was met by making temporary connections with an additional source of supply, nearly ready for introduction. The break and the emergency work are described in what follows.

When the typhoon occurred Manila was being supplied with water by a 50,000,000-gal.-daily conduit leading from an impounding reservoir at Montalban to a distributing reservoir near the city (see map). The water consumption of the city is about 25,000,000 gal. per



LOCATION OF OLD AND NEW SOURCES OF WATER SUPPLY, MANILA, P. I.

day. The supply conduit undercrosses the Mariquina River by means of a 36-in. bell-and-spigot cast-iron inverted siphon, laid in 1907, in a trench about 8 ft. beneath the riverbed. During ordinary river stages the water is but knee deep and in the dry season much shallower. The pipe line was built in open trench, with no trouble at all, by diverting the water from the ditch where the pipe was being laid.

A few years ago a very heavy flood occurred, calculated by the writer at 65,000 sec.-ft., which filled the 191-ft. spillway of the Montalban dam to the limit it was designed for, nearly to a 20-ft. depth. This discharge was the maximum known from careful observations and computations for 30 years.

In the typhoon of Sept. 3 and 4, 1929, the water rose to a height of more than 30 ft. over the widened spillway and stood 10 ft. high inside the gatehouse, judging by the watermarks left there. The runoff is estimated at 110,000 sec.-ft. from a watershed of 108 miles. The flood washed out about 3 miles of private highway leading to the dam; washed out several steel bridges, including one 60-ft. steel bridge on which the pipe line was carried across a small tributary below the dam; flooded most of the Mariquina River valley; and deposited trees several feet in diameter on the rice fields 30 ft. or so above the normal river level. It also undercoursed the pipe line and dug a channel there about 12 ft. deeper than it was before. This let down the pipe line to the newly formed riverbed and in doing so pulled the pipe joints apart and carried ten 12-ft. lengths some distance downstream. On the morning of Sept. 4 it was noted that the reservoir height dropped rapidly. Investigating parties were sent out to find the cause of the trouble, which was eventually located in a break of the cast-iron pipe line undercrossing the river. The search parties returned to Manila at 6 p.m. Measures were immediately taken to prepare for the repair of the break in the 36-in. cast-iron pipe under the river, but as the river was under flood conditions, water had to be provided from some other source.

As the Novaliches earth dam and the 80,000,000-gal.-daily tunnel and conduit from it to the location of the filtration system under construction was completed recently and the reservoir formed by this dam was filled by the exceedingly heavy rains since June, measures were taken to make a temporary connection from the end of the tunnel to the old aqueduct by means of ditches and wooden flumes to carry the water across several ravines. At 7 a.m., Sept. 5, 600 laborers were set to work, working 24 hours a day in two shifts. The flume, carrying some 15,000,000 gal. per day, was completed in about 36 hours.

As soon as the temporary flume was completed seven parallel lines of 12-in. cast-iron pipe were built on the other side of the rivulet to our aqueduct. These seven pipe lines carry about 19,000,000 gal. daily. Up to date Manila is served with the full amount of water needed, through the temporary connections.

A description of the water supply of Manila, including the pipe line on which the recent break occurred and also the additional supply tapped by the emergency connection, appeared in *Engineering News-Record*, May 30, 1928, p. 841.—Editor.

Water-Works Design Provides for Earthquakes

Consideration of the possibility of earthquakes has entered into the design of the building of the San Jose water-works and into the type of equipment selected for pumping the water. The precautions taken are described in a paper by J. W. Ford, abstracted in the *Bulletin* of the Seismological Society of America. As electric power is used to drive all pumps supplying the city with water from wells, an independent electric generating system has been provided to tie into the line coming to the plant from the central station. These auxiliary generators are driven by gasoline engines started by compressed air. Electric power is used to drive the compressor, but four holders store enough air to start the engines, and, as an additional precaution, another air compressor operated by a Ford motor has been supplied. This plant has sufficient capacity to operate two well pumps and two booster pumps delivering about 3,000,000 gal. of water per day. This independent generating plant is housed in a brick building 50x110 ft. with a galvanized-iron roof supported on rather heavy timber trusses resting on the walls. Although the walls of the building are a foot thick and laid in cement mortar, it was recognized that they might not be able to stand the strain of a severe earthquake. To provide against this contingency, a heavy frame was built just inside the brick wall to aid in supporting the roof and to prevent the bricks from falling inward.

Letters to the Editor

Chance Pollution of Water Supplies From Wells

Sir—The water-borne typhoid outbreak at Fond du Lac, Wis., noted in your issues of Oct. 31 and Nov. 7, 1929, pp. 703 and 713, calls to mind an incident which occurred at Sidney, Ohio, while I was resident engineer on an investigation of an increase in the supply. New wells were drilled at a considerable distance from the wells then in use. As one of the new wells was being sunk an increase in the supply from some of the old wells was noticed. In fact one of the old wells became a flowing well, which had never occurred before.

It should be remembered that when any drilling is going on in the vicinity of a water-supply well it is necessary to be especially vigilant, as the new drilling may connect water sources which have never been connected.

Columbus, Ohio, Nov. 17, 1929. SAMUEL P. BAIRD.

Improvements in the Imhoff Sewage Settling Tank—Correction

Sir—May I call attention to some apparent typographical errors in Otto Mohr's article, "Improvements in the Imhoff Settling Tank," in your issue of Oct. 24, 1929? In the second column of the table on p. 648 it seems to me that "effluent" in lines 5 and 6 should read "influent" and that in the last line of the table the sludge analysis should read 15.9 per cent solids; 84.1 per cent water. A copy of one table corrected accordingly and somewhat rearranged is given herewith.

OPERATING RESULTS IMHOFF AND OMS TANKS AT SINGEN, GERMANY, JAN. 18, 1929

	Imhoff Tanks			OMS Tanks		
	Influent	Effluent	Per Cent Reduction	Influent	Effluent	Per Cent Reduction
Chlorine, p.p.m.	.....	555	.....	.....	555	....
$KMnO_4$ consumption, p.p.m.	4582	2970	35.3	4582	1327	71.0
Settleable solids, c.c. per liter	7.2	1.4	80.5	7.2	0.3	95.8
Total solids, p.p.m.	1470	84	94.4	1406	80	95.0
Mineral solids, p.p.m.	540	26	95.1	584	20	96.4
H_2S	Negative		.....	Negative		....

Sludge from the OMS tanks contained 15.9 solids and 84.1 per cent water.

EARLE L. WATERMAN,
Professor of Sanitary Engineering,
State University of Iowa.

Iowa City, Iowa, Nov. 12, 1929.

Stadium Designs

Sir—In the article "The Good-View Factor in Stadium Design," by Myron W. Serby, in your issue of July 11, 1929, p. 59, the second illustration carries the caption "Typical Stadium With a Capacity for About 90,000," and I am afraid that this gives your readers an erroneous impression. The stadium design shown is in its principal features typical only of the work of my office, and these features are protected by patent issued to me Sept. 20, 1927 (Design Patent No. 73499, filed July 12, 1921). Anyone reading the article would assume that this "typical" design is available for the free use of any designer, whereas I reserve all rights to the basic features shown in the plan—namely, that the outer edge of each side is bowed outwardly from the lines of the side seats. For some years I have been incorporating these features in designs which I have made, and a number of these stadium designs have already been executed in construction, notably the Cornell Crescent at Ithaca, N. Y., the University of Denver Stadium at Denver, Colo., and the Dyche Stadium at Evanston, Ill.

New York City, Nov. 7, 1929. GAVIN HADDEN, Civil Engineer.

* * *

Sir—Fig. 2 in my article, referred to by Gavin Hadden, is similar in general outline to the ground plan of the Pasadena (Calif.) stadium designed by Myron Hunt. This is a cut-and-fill project seating about 75,000. Both inside and outside perimeters are cut back at intervals, but the horseshoe shape with side section wider than end section is characteristic of the design, and there is an increased number of rows of seats on the sides obtained by racking out the perimeter. As this structure was designed and completed before Mr. Hadden received his patent, it would follow that the idea of the crescent had been in use prior to his claiming date.

Incidentally, the visibility formulas, which comprised the subject matter of my article, were of general applicability. The design shown in Fig. 2 was merely presented as a typical example of a large stadium in which the good view factor would be of major importance. There are numerous other typical designs available.

New York City, Nov. 11, 1929. MYRON W. SERBY, Consulting Engineer.

Traffic Vibration and Noise

Sir—I have read with much interest the article, "Combating Traffic Vibration and Noise," which was published in your issue of Oct. 31, and would like to offer some comments on the problem as presented.

It is stated that "increased traffic facilities are accompanied by increased height of buildings." We think that this is placing the cart before the horse, because it is the increased height of buildings and their consequent increase of population density that compel increased traffic facilities.

The article also says that "there can be no question that noise and alarm are adverse to efficient production." While it would seem from casual observation that this might be true, it is as yet not a proved fact. Certain records prove that noise is a stimulus and assists effective work. At the present time there is much study being given to this phase of the noise problem by the National Safety Council research committee on noise and its relation to accidents. Reference is made to the reports of this committee for 1927, 1928 and 1929. The committee, which includes in its membership many men of high standing in the technical world, says this in its report for 1928: "After continuing to work for several years we came to the conclusion there was absolutely nothing available to prove conclusively that noise was harmful to the human system, so the present research work was outlined." In the 1929 report preliminary data are given on research endeavor which indicate that soon we shall have definite proof of the effect of noise on the human being.

We are chiefly concerned, however, with the discussion of traffic noise as produced by rail traffic. This may be classified as from surface cars and subway cars. For the present we shall restrict our discussion to surface cars, as their application is so much greater than subway and they affect a far larger proportion of our population.

It is admitted that steel wheels running on steel rails are the most prolific source of street-car noise. The other causes, such as grinding wheel flanges, clicking joints, grinding of brake shoes, electrical hum, rattle of loose parts and vibration of car body are relatively unimportant, gearing noise alone of the sources listed being of major importance.

We do not admit or believe that "vibration is caused chiefly by the periodic succession of wheel loads passing over ties and by tractive and braking forces between wheels and rails." A double truck car traveling at a rate of 20 miles per hour might cause vibration on the order of 4,000 per minute due to transference of load from tie to tie. Actually the rate of vibration of street car rail produced by a car traveling at 20 miles per hour is of the order of 12,000 per minute, as determined by a recording instrument. The vibration is not sufficiently uniform to support the theory of its being caused by tractive or braking forces. We are inclined to the belief that roughness of wheel and rail is the principal cause of vibration and that if a perfectly smooth wheel rolled over a perfectly smooth rail the vibration would be so small as to constitute no appreciable problem.

As to the comments on a "noiseless" street car, it is admitted that worm gearing eliminates gear noise, but motors have always been spring-suspended except in a few unusual cases. Likewise motors have always been series-wound except in the case of alternating current, which is seldom used, so this constitutes no change and the only motor noise is that

produced by the brushes rubbing on the commutator. Ball bearings per se are no quieter than sleeve bearings. It is the abuse of the sleeve bearing that has allowed it to come into disrepute.

The statement that wheels and track foundation as sources of noise "remain untouched" cannot be passed unchallenged. The Pullman Company many years ago developed a car wheel with a composition center which helped to reduce noise. The Meade cushion wheel, now controlled by the J. G. Brill Company, was developed to reduce noise and improve riding qualities. This wheel employs a section of rubber between the tire and the wheel center. This and other forms of car wheels using rubber have been tried out with success except where excessive braking with consequent high temperatures occur. With improvements in rubber manufacture, it is confidently expected that a resilient car wheel will soon be available which will meet all conditions.

As to track construction, the Philip Carey Company has marketed a line of cushioning material for rail which goes far to absorb vibration and noise. It is admitted that the trend of recent track construction in cities has been toward steel ties and solid concrete, which greatly increase street-car noise, but even with such construction it is practical to insulate the rail for vibration.

Our conclusions as to the principal causes of street-car noises are that they are due to wheel and rail contact sounds upon which unsprung weight and mass exert a big influence, track foundation, gear noise, trolley noise and many minor sources. It must be realized that the street-car noise problem has two phases, one being the noise heard from within the car as affecting the passengers and the other being the external noise affecting the pedestrian and the dweller in near-by buildings.

The railways of the country are thoroughly alive to this situation and are spending much effort to effect a solution of the problem. The American Electric Railway Engineering Association in 1925 appointed a committee to study and report on noise reduction. This committee has done much research work and has reported upon it each year since its inception. A perusal of these reports might be of interest to those concerned with the noise problem.

New York, N. Y., Nov. 5, 1929. H. S. WILLIAMS, Chairman, A.E.R.A. Noise Reduction Committee.

Why the Mississippi Meanders

Sir—That the saturation of a stream by the eroded bank material may affect the direction of the flow of the stream seems plausible. It is not so apparent that it is the total cause of stream meandering. Neither is it apparent that by the use of this principle the simple and inexpensive installations described in *Engineering News-Record* of Oct. 17, 1929, p. 619, by P. Claxton would be a sufficient remedy.

Flowing water, in common with all falling bodies, will travel the direct and shortest route toward the center of attraction of gravitation if not influenced by other forces. The flowing river constantly seeks, from its source to its mouth, a straight course, and the very fact that it will not change the direction of its flow without resistance makes it crooked. Early in its downward course the stream encounters a greater resistance from one bank than from the other opposite. The result is a succession of bends, and this whether the banks are of solid rock and the water is apparently clear, or whether the banks are of sand and the water is overloaded with silt, the only difference being in the matter of time, one requiring geological ages, and the other hours.

When the thread of the stream shifted from the west bank at Island 26 (illustration p. 620) to the east bank of the river, it met opposition at the Ashport point with disastrous results to the point, as is shown by the distance the river cut into it. But the point did not relinquish its position without a struggle and in this struggle the current of the river was deflected toward the west and against the sand-bars on that side. They, in turn, offered their resistance with a resulting deflection. These two deflections of current and two erosions of bank would have occurred irrespective of any influence of the silting of the bend below Ashport.

It is evident that some change in the river above Island 26 caused the thread of the stream to shift from the west side of the island to the east side. If dikes 1 and 2 would have successfully held the river out of the east channel, still the influence above would have shifted the thread of the stream toward the east, eventually cutting Island 26 back to the dike heads. This change in direction of the current just above Ashport bend would have tended toward locating the thread of stream along the chord of the bend. A glance at the illustration shows that in such case the system of dikes proposed would have reduced the channel to a point which would not have been permissible. All this to emphasize that the problem is complicated and the solution difficult.

Topeka, Kan., Oct. 23, 1929. LLOYD B. SMITH.

Federal or State Reclamation?

Sir—Your editorial in the Nov. 7 issue entitled "Reclamation or Free Storage" is especially interesting to us where reclamation is vital to future development.

The reference to "interest-free irrigation financed by the ample treasury at Washington" is, perhaps, misleading. Reclamation has been financed not from funds of the federal treasury derived from the whole country but from the reclamation fund derived from the revenues from the public domain. This public domain is inherently the property of the public land states administered as a trust by the federal government. Further, the reclamation fund is a revolving fund and is really revolving.

This is not a sectional problem. The future prosperity of the whole nation depends upon the full development of all sections. It is already recognized that undertakings too large for a state or for the property immediately benefited are proper duties of the national government. River and harbor work and Mississippi flood control are examples. It would be only a broadening of this policy for the government to build flood-control and storage works on the streams of the West. "Those who believe that governments should do no more than govern" are in a strong position, in theory, but in practice they are rather overwhelmed with precedents already established. Rightly or wrongly, we are pretty definitely committed to a general policy of "federal aid." The immediate practical problem is to determine what developments will indirectly repay this aid through the upbuilding of the whole country.

Western reclamation, both federal and private, has been and will be a great factor in the progress of the nation. The products of Western irrigated lands are supplemental and complementary to rather than competitive with the agricultural products of the Mid-West and East, and the development of these Western communities dependent upon irrigation builds an important market for products of the industrial sections.

Helena, Mont., Nov. 13, 1929. J. S. JAMES, State Engineer of Montana.

When the President proposed a review of reclamation practice, he pointed out that the federal reclamation system was devised for the purpose of making desert public land suitable for cultivation and that it was actually applied largely to the reclamation of private land. That evils of many kinds resulted from this practice in connection with the interest-free provision is as clearly evident in Montana as elsewhere.

Claims that the public land "belongs" to the Western states or that the money used for reclamation does not come from the federal treasury are not easy to understand. As Mr. James doubtless knows, prior to 1902 is was not even earmarked for use in the West; the framers of the reclamation act of that year named certain particular items of income merely as a political artifice to help the passage of the act.

The statement of the letter that "undertakings too large for a state or for the property immediately benefited are proper duties of the national government" is far too broad to be accepted. But more pertinent at the moment, in view of the President's suggestion that the states handle all development below the storage, is Mr. James' implied claim that reclamation development is too large for that state. Not a single one of the federal projects, and for that matter no other project, involves expenditures nearly as great as those which the states undertook and easily carried out under the federal-aid road law. A project costing seven or eight millions is a large and important one, yet the cost could easily be managed by the state concerned.—EDITOR.

News of the Week

Valuation of New York Central System Announced

A total final value of $1,578,206,614, including $47,331,898 for working capital, has been placed by the Interstate Commerce Commission upon the properties of the 70 railroads comprising the New York Central system used for common-carrier purposes as of various dates ranging from 1915 to 1927. The New York Central contended for an aggregate value for system-owned properties of approximately $1,800,000,000, exclusive of working capital. This sum contemplated a much smaller deduction for depreciation than tentatively made by the commission and a large provision for appreciation.

The commission's final report, made public Nov. 27, was completed in July, two months after the decision of the U. S. Supreme Court in the O'Fallon case. In a dissenting opinion to the valuation report, Commissioner Eastman declared that the court's decision makes it desirable for the commission to review its methods of valuation and to consider whether they are consistent in all respects with the views expressed by the court.

Time Extension Requested by Contractors on Diablo Dam

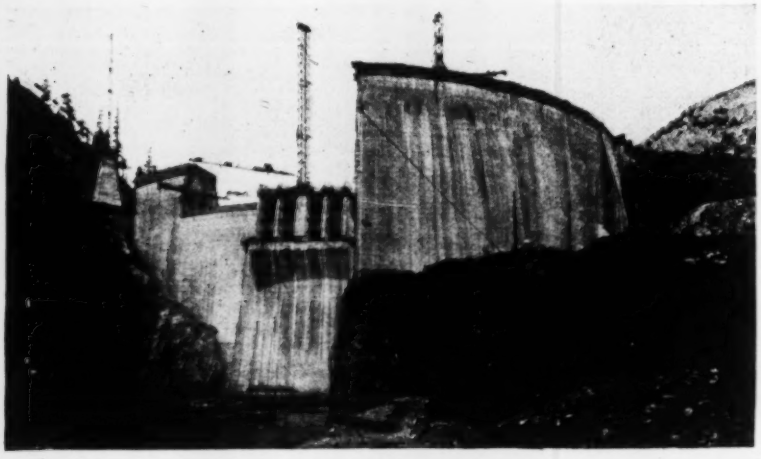
The city council of Seattle, Wash., has been informed by representatives of the Winston Brothers Company, contractor, that the Diablo dam, under construction for the Diablo unit of the Skagit hydro-electric project, cannot be completed before another year. This is considerably later than the time specified. A request for a year's extension has been made to the council, but has not yet been granted. The contractors place the blame for the delay upon certain changes ordered, which necessitated extra rock excavation and the pouring of additional concrete. A description of the project appeared in *Engineering News-Record*, Aug. 29, 1929, p. 320.

Construction of Railroad Branch in Kentucky Authorized

To reach coal and timber lands on the Levisa Fork of the Big Sandy River in Pike County, Ky., the Levisa River Railroad, subsidiary of the Chesapeake & Ohio, has been authorized by the Interstate Commerce Commission to build a 28-mile line from a connection with the C. & O. at Millard east to the Kentucky-Virginia state line. Cost of construction of the single-track line, laid with 100-lb. rail, is estimated at $4,804,000, of which $1,838,900 is for grading, $588,500 for tunnels and subways and $573,900 for bridges, trestles and culverts. The road plans to begin construction work immediately.

Non-Magnetic Yacht "Carnegie" Destroyed by Fire

While on a three-year cruise around the world for the study of magnetism and atmospheric electricity the non-magnetic yacht "Carnegie," owned by the Carnegie Institution, of Washington, D. C., was totally destroyed in Apia Harbor, Samoa, by an explosion and fire which occurred while taking on fuel. The vessel was 155½ ft. long and had a displacement of 568 tons. All materials entering into her construction were non-magnetic, including locust wood nails, copper and bronze bolts and fittings. For propulsion during calms she was fitted with a small non-magnetic four-cylinder engine.



DIABLO DAM ON NOV. 20, 1929
Water level in this view is 88 ft. above bottom of the dam, which has a total height of 425 ft.

Supreme Court Takes Action in Two Water Disputes

Appointment of a special master to handle the case arising from the dispute between Connecticut and Massachusetts over the diversion of the upper tributaries of the Connecticut River was announced by the U. S. Supreme Court on Dec. 2. The Commonwealth of Massachusetts has been made a defendant in the suit brought by the State of Connecticut to enjoin the Boston Metropolitan Water District from diverting water from the Swift and Ware rivers, which are tributaries of the Connecticut. The protest of the State of Connecticut is that the diversion will impair the navigability of the Connecticut River. The Supreme Court has fixed Jan. 6 as the date on which Massachusetts will be permitted to amend its answer to the suit.

In a similar case between the states of New York and New Jersey over the proposed diversion from the upper tributaries of the Delaware River to augment the New York City water supply, the Supreme Court has declined to appoint a special master. A hearing has been scheduled for Jan. 6. The complaint filed by the State of New Jersey alleges that the New York authorities contemplate using part of the diversion for the generation of power. The State of Pennsylvania has officially decided to join with New Jersey in this action.

Los Angeles Union Station Case Decided in Favor of Railroads

In a decision rendered Nov. 25 the U. S. Supreme Court stated that a court does not have the power to compel the Interstate Commerce Commission to require the construction of a union station in Los Angeles, Calif., by the Atchison, Topeka & Santa Fe, the Southern Pacific and the Los Angeles & Salt Lake railroads. The court stated that if Congress had intended to give the commission power to require such construction it would have so stated by express provisions; in the absence of such provisions, such an intention cannot be ascribed to Congress.

The case, which has had a long and involved legal history, was started in 1921 when the California State Railroad Commission ordered the three roads mentioned to build a union station on what is known as the Plaza site in Los Angeles. On appeal by the railroads, the California Supreme Court declared that exclusive authority in the matter had been assumed by Congress by the transportation act of 1920 and that the State Railroad Commission lacked jurisdiction. Following this decision the commission appealed to the U. S. Supreme Court for a review of this

decision and also instituted proceedings before the Interstate Commerce Commission for an order from that body requiring construction of the station. The commission held that it was without authority to order construction of the station but that it did have jurisdiction over certain track changes necessary to enable the three lines to reach the proposed site. The commission also expressed its willingness to approve such changes.

The first part of this decision was carried to the Supreme Court of the District of Columbia, the State Railroad Commission requesting an order of mandamus directing the Interstate Commerce Commission to order the construction of the station. The petition was dismissed by the court, whereupon an appeal was taken to the U. S. Supreme Court, resulting in the present decision.

In the meantime, in a decision handed down April 7, 1924, the U. S. Supreme Court had affirmed the judgment of the California Supreme Court already referred to, holding that the relocation of tracks incidental to the construction and use of the proposed station was under the jurisdiction of the Interstate Commerce Commission and that, until an order for trackage changes had been issued, the railroads could not be required to proceed with the construction of the union station.

Tampa Votes Airport Bonds

Tampa, Fla., on Nov. 27 voted $750,000 in bonds to finance the building of a modern airport. The vote was more than two to one in favor of the issue. Immediate steps will be taken to issue and sell the bonds in order to facilitate construction work.

A special committee will be appointed to select a site from the number that may be considered. The War, Navy and Commerce departments of the federal government will be asked to assign representatives to co-operate with the committee.

Court Decision Gives Rochester Right to Enlarge Water System

Review of the proposed $22,000,000 Honeoye Lake water-supply project of Rochester, N. Y., has resulted in a unanimous decision by the Appellate Division, Third Department, giving the city the right to proceed with the plan and upholding the constitutionality of special legislation giving the city permission to compensate property owners for "consequential" or intangible damages. The project involves the ultimate acquisition of about 30,000 acres of land, the construction of a dam approximately 800 ft. long and 60 ft. high expanding Honeoye Lake to three times its present area, and the building of an 18-mile pipe line and, possibly, a filtration plant. Two villages and 9 miles of highway will be submerged. The project, when completed, will yield an estimated total of 55,000,000 gal. daily, more than doubling the present supply of the city.

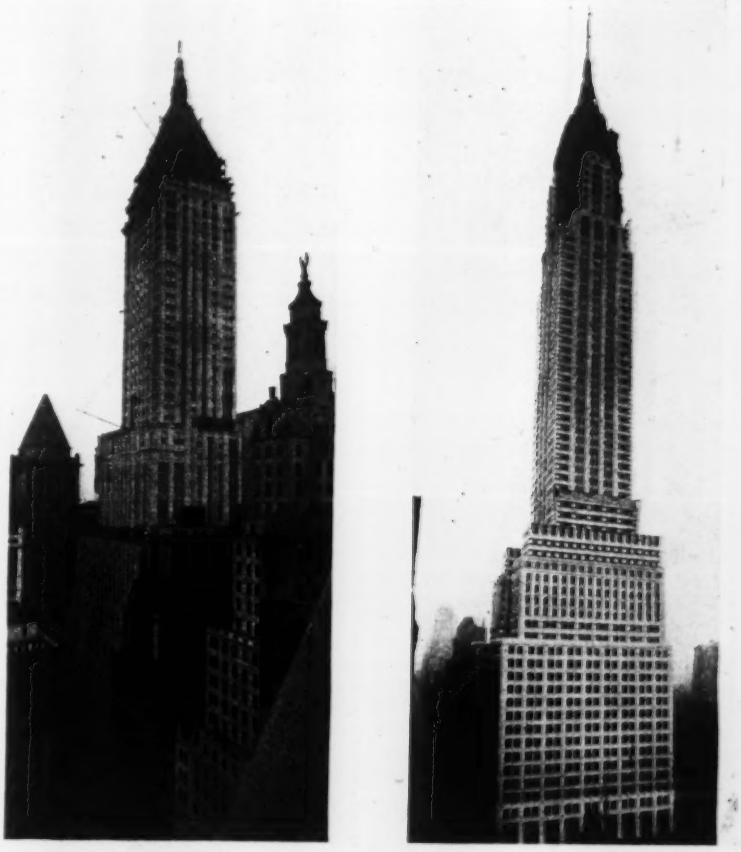
Building Height Record Exceeded by Two Structures

Woolworth Tower Overtopped by Both Chrysler and Bank of Manhattan Buildings

ERECTION of the topmost steelwork on both the Chrysler and the Bank of Manhattan buildings about the middle of November gave New York City two structures more than 900 ft. in height. The Chrysler Building, with the aid of a 185-ft. finial tower, reaches the unprecedented height of 1,030 ft., 30 ft. higher than the Eiffel Tower in Paris. The 50-ft. flagpole atop the Bank of Manhattan Building at 40 Wall St. extends to an elevation of 925 ft. above the sidewalk. The comparable height of the Woolworth Building is 792 ft., top of flagpole. Conflicting reports exist as to the number of floors in the structures, but from reliable sources it is said that the Chrysler Building contains 66 stories and six pent-house floors, reaching to elevation 845 ft. above the sidewalk, while the Bank of Manhattan Building contains 60 stories and twelve pent-house floors, extending to a height of 875 ft. above the sidewalk. The steel tonnage in the Chrysler Building is 21,000; that in the Bank of Manhattan Building 18,500.

An unusual speed record has been set up in the construction of the Bank of Manhattan Building. Foundation work was begun May 1 while demolition of the old buildings on the site was still under way, and the foundations were completed ready for the steel on June 17. The first grillage was set on June 22, and the 60th floor completed on Oct. 11. From this point upward steel erection was carried on more slowly on account of high winds, but the last piece of steel was erected on Nov. 12. The accompanying photographs were taken on Nov. 18.

The Chrysler Building, too, was erected with unusual speed, inasmuch as steel erection began on April 4. Somewhat unusual erection procedure was involved in lifting the finial tower into place. The tower consisted of a framework of angles and plates, the 8x8x1-in. corner angles, forming a base 8 ft. square, being drawn to a peak in a length of 185 ft. The tower was trucked to the job in sections, lifted to the top of the steelwork and lowered inside of the building, where it was assembled on a timber platform at the 65th floor. Completely assembled, the tower weighed 27 tons. A connection was supplied a short distance above the center of gravity of the tower and it was lifted into position by means of a



STEELWORK COMPLETED ON TWO TALLEST BUILDINGS
Left, Bank of Manhattan Building, 925 ft. high; right, Chrysler Building, 1,030 ft. to top of finial.

set of falls from a 75-ft. guy derrick, resting on an outrigger platform at the top of the steelwork.

Another important record which applies to both structures is that no one was killed during the entire erection of the steelwork.

South Carolina and Georgia to Rush Road Building

Decision by the State of South Carolina to issue $10,000,000 in state bonds as speedily as practicable as a part of the $65,000,000 highway bond issue authorized by the legislature last year to complete a state system of hard-surfaced roads was arrived at in a conference of state highway officials, legislators and Gov. John G. Richards. Bids on the issue will be opened Dec. 17. Following the marketing of the bonds the highway program will be pushed.

State highway construction contracts amounting to $1,000,000 will be let in January and February next, according to announcement of the Georgia Highway Commission. The highway department is working on a five-year building program, but details will not be decided upon until reorganization of the commission on Jan. 1, when W. C. Vereen, of Moultrie, succeeds Stanley S. Bennett, of Quitman, as a member. Sam Tate is chairman of the commission.

City Managers Get $75,000 for Research of Methods

The International City Managers Association at its Forth Worth convention Nov. 20-23 elected the following officers for the ensuing year: president, Clifford W. Ham, city manager, Pontiac, Mich.; first vice-president, Stephen B. Story, city manager, Rochester, N. Y.; second vice-president, Charles A. Carran, city manager, East Cleveland, Ohio; third vice-president, H. L. Woolhiser, city manager, Winnetka, Ill. Clarence E. Ridley, 923 East 60th St., Chicago, continues as executive secretary. The 1930 convention will be held in San Francisco. Louis Brownlow, chairman of the research committee, announced that the various foundations and institutions interested in the aims and purposes of the association had made grants of $25,000 annually for the next three years to carry on research projects.

Work of the convention had to do with the following topics, discussed usually by at least four members: government responsibility for public health and social work; training for public administration after entry into the service; problems of the manager in large and small cities; the manager's part in determining public policies; reciprocal duties of manager and council; public relations; administrative practice, including airport control and personnel problems; city planning; municipal operation of utilities.

Engineer Elected President of Mexico

Pascual Ortiz Rubio, President-elect of Mexico, is one of the most prominent hydraulic engineers of that country. During his career he has served as Secretary of Communications and Public Works and as a Brigadier-General in the engineering corps of the Mexican army. As the confidential representative of the Mexican government, he has visited many countries both on this continent and in Europe. During these visits he made studies of irrigation works in Spain, France, Italy and Egypt.

The Business Outlook

The gradual slackening of business activity seems this week again to be proceeding according to schedule. This means that the slowing up is about what might be expected at this season plus what would be natural in the light of the abnormal or boom conditions that existed up to the middle of the year. There is little direct or conclusive evidence that the stock-market collapse has in any great degree accelerated the decline which would otherwise have occurred. We look for it to continue without marked change until early in January. If business could be talked down, we should have had a more pronounced recession than has so far been seen. If it can be talked up, next year should be a record breaker.

—The Business Week, Dec. 4.

Zoning Appeal Actions Set Aside in Two States

During the month of November two cases are recorded in which the actions of boards of zoning appeal have been set aside by decisions of the supreme courts of the states involved. In New Jersey the Supreme Court decided that the Passaic board of adjustment had not acted in accordance with its proper powers; and the Supreme Court of the State of Illinois rendered an opinion in which the section of the state zoning law authorizing the board of zoning appeals in the city of Chicago to make variations in the application of the law was held unconstitutional.

The Passaic case involved the construction of a 100-car public garage and service station on the boundary line between commercial and residential zones. The board of adjustment in that city, when appealed to for a reversal of the decision of the building inspector prohibiting the erection of the structure, recommended to the board of city commissioners that the permit be granted. Its recommendation was followed by the board of commissioners, which adopted a resolution ordering the supervisor of buildings to issue the permit. The court held that the board of zoning appeals had the power to set aside the requirements of the zoning law if, in its opinion, such action was justified, but that the board of city commissioners had no such authority. Inasmuch as the action of the first board was recommendatory and not determinative, and as the board of commissioners was without jurisdiction, it follows that the actions of both boards must be set aside.

In Illinois, Sec. 3 of the zoning act of 1921 has been held to be unconstitutional, as it is an attempt to delegate legislative power to a municipal board.

This portion of the act conferred upon a board of appeals, created by municipal authorities, the power to vary or modify the provisions of the zoning ordinance whenever in the opinion of the board a compliance with the provisions would result in practical difficulties or unnecessary hardships. The act did not provide what these "practical difficulties or unnecessary hardships" should be, but left that interpretation to the discretion of the board. "Such an authorization," the court pointed out, "is arbitrary and unconstitutional because it is a delegation to an administrative body of the general power of legislation, which can be authorized by the general assembly alone."

Application had been made to the Chicago commissioner of buildings for a permit to erect a twenty-story apartment building in what is known as a fourth volume commercial district. The proposed building would exceed the alley line height limit by 141 ft., and for that reason the commissioner of buildings would not issue the permit. Appeal was made to the board of appeals, which after a hearing on the case and an examination of the premises ruled that compliance with the regulations of the zoning ordinance in this case would entail "unecessary hardship" and therefore made a variation in the application of the ordinance. Two neighboring property owners thereupon carried the case to the Superior Court of Cook County and then to the Supreme Court of Illinois.

Northern Alberta Railways Plan Extensions

To meet the traffic needs of the district supplied by the Northern Alberta Railways and in fulfillment of statements previously made that 60 miles of branch lines would be built within five years, the directors of the railway have decided to recommend to the dominion government the commencement in 1930 of a line from Hythe to Rolla, a distance of 50 miles, and from Fairview westerly, a distance of 15 miles. In addition, the Northern Alberta Railways during the coming year will undertake to investigate the traffic possibilities of an extension west from Spirit River and from a point at or near Grimshaw to serve the Battle River district, in which considerable settlement has taken place. The Northern Alberta Railways is jointly owned by the Canadian Pacific and Canadian National railways.

New York Sues to Recover Excess Payments on Queens Sewers

A civil suit has been filed in the Supreme Court by the city of New York to recover $214,809, representing an alleged excess paid on sewer materials in the borough of Queens, from Maurice E. Connolly, former borough president of Queens; Clifford B. Moore, consulting engineer; Frederick Seely, assistant engineer, and certain other defendants. The basis of the suit is specified in a 45-page complaint filed by the city which alleges, in part, that in July, 1923, the city paid $32.50 per linear foot for precast reinforced-concrete sewer pipe of which the reasonable value was $18.25. In October, 1925, it is stated, the city paid $33 per linear foot for 36-in. pipe worth $4.75 and 33-in. pipe worth $3.70. The successful bidder in both instances was the Awixa Corporation, one of the defendants. The complaint states that Connolly and John M. Phillips, agent for the patented pipe used, conspired in the acceptance of these excessive bids, and also that corporations bidding on sewer jobs had their prices controlled.

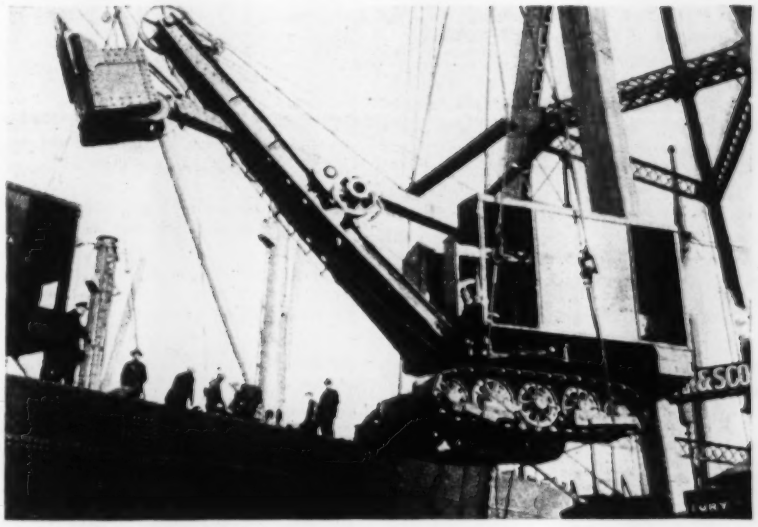
The present suit is the first of a series to be initiated by the city, according to Corporation Counsel Arthur J. W. Hilly. Most of the subsequent suits are to be directed against contractors.

Washington Decision Assures Hydro-Electric Project

The city commission of Centralia, Wash., has overcome another of the long series of legal obstacles placed in its way to prevent resumption of the construction of the city's $1,000,000 hydro-electric power project on the Nisqually River. Judge W. O. Chapman, of Pierce County, recently dismissed the petition for a writ of prohibition asked by H. M. Jones, taxpayer and employee of the Eastern Railway & Lumber Company. A petition for a second writ, which sought to restrain the city from passing a city ordinance to include the power project costs in the 1930 budget, was quashed by Judge Chapman. Motions by attorneys for Mr. Jones to have declared invalid the contracts which were approved at two city elections were overruled.

Municipal Power Plant Sold to Private Corporation

Another municipally owned power and light business has changed hands to private ownership in the sale of the Kamloops (B.C.) plants to the British Columbia Electric Railway Company. The company's offer of $600,000 for a hydro-electric plant developing 2,000 hp. and a steam plant of 1,500-hp. capacity was accepted by the city council and ratified by the voters on Nov. 20. The company will make $100,000 worth of improvements and extensions within the next thee years.



LARGE GASOLINE SHOVELS SHIPPED WITHOUT DISMANTLING

Two 1¼-cu.yd. gasoline shovels were loaded without dismantling over the side of the S. S. "Cristobal" by the 100-ton derrick boat "Century" of the Merritt-Chapman & Scott Corporation at the steamship's pier in New York on Nov. 12. The shovels, weighing approximately 45 tons each, were loaded on the forward deck of the vessel. They were consigned to Al Geddes, who has a subcontract under the Austin Engineering Company for grading work on the Albrook airfield at Balboa, Canal Zone.

Brief News

FLOOD-CONTROL CONSTRUCTION FUNDS previously allotted to the Boeuf and Atchafalaya floodway work have, by decision of the War Department, been transferred to cover emergency levee and revetment work on the Mississippi. Unusually low water during the fall has caused considerable caving of levees close to the riverbank.

PIER EXTENSIONS at Weehawken, N. J., on the west side of the Hudson River, have been refused by the War Department, on recommendation of Major-Gen. Lytle Brown, Chief of Engineers, who says the present channel width is required by the river traffic.

A HYDRO-ELECTRIC POWER PLANT has been opened at Cardaun, Italy, with a capacity of 270,000 hp. A tunnel 16 km. long and 3 m. in diameter connects two existing lakes to a newly created lake behind a large dam, whence the water is conducted to the power station. Machinery was supplied by American and German companies.

HEADQUARTERS OF THE MISSISSIPPI RIVER COMMISSION were moved from St. Louis to Vicksburg on Dec. 2 in accordance with orders recently issued by the Chief of Engineers.

EIGHT TRAFFIC LANES are to be provided on the trans-island boulevard which the Metropolitan Commission of Montreal is planning to construct next year from Ste. Anne de Bellevue, at the west end of Montreal Island, to Bout de Isle, at the other end. Engineers are now completing the surveys and options have been taken on the property that it will be necessary to secure. A 200-ft. right-of-way is to be provided for the boulevard. At first the paved surface will have a width of 80 ft., allowing for four lines of traffic in each direction.

A SCENIC HIGHWAY between Golden and Revelstoke, B. C., will be completed by 1932, according to plans of the provincial and Canadian governments. About 150 miles of construction is involved, of which 29 miles has already been built north from Revelstoke by the province.

MODIFICATION OF THE BULKHEAD LINE on the easterly shore of the North River, between West 65th and West 70th Sts., New York City, will be the subject of a hearing by the New York Harbor Line Board in New York on Dec. 20. The application is made jointly by the city department of docks and the New York Central Railroad, and requests that the line be moved 100 ft. outshore from its present location.

CITY MANAGER GOVERNMENT will be instituted on Jan. 1 in Calgary, Alta., by vote of the citizens at a recent election. At present Calgary has the commission form of government.

OMAHA AND COUNCIL BLUFFS, NEB., are to vote on a proposal to purchase from the Omaha & Council Bluffs Street Railway Company a toll bridge across the Missouri River between the two cities. The company has set a price

upon the structure of $4,155,296. This is based upon an appraisal to which is added the estimated net revenue of the bridge for three years, the time the company assumes it will take the city to build a possible competing bridge. Cost estimates for such a new bridge vary from $1,775,000 to $3,000,000.

DEDICATION of the new administration building of the York Water Company, York, Pa., took place Nov. 21. A description of this building appeared in *Engineering News-Record*, June 13, 1929, p. 950.

New Water Supply Planned for Calgary, Alberta

A new water-supply scheme for Calgary, Alta., involving an estimated expenditure of $3,770,000, has been recommended to the city by a Toronto firm of consulting engineers, who have suggested the Elbow River as a source of supply, the construction of a new reservoir five-eighths of a mile south of the city limits, a new filtration plant, a new pumping station and new distribution mains. The proposed project will involve construction extending over a period of two and a half years. The present supply of water is taken from the Bow River above the city. The proposed new supply from the Elbow River involves a dam 800 ft. long on the crest, creating a reservoir with a surface area of 900 acres and impounding 3,600,000,000 gal., or 90 days' supply for 200,000 persons. Near the proposed reservoir, the water-purification plant would be erected with a capacity of 27,000,00 gal. of filtered water daily. The scheme indorsed by the consulting engineers is the cheapest of eleven projects which were under consideration.

Cape Fear River Crossing Nears Completion

Two bridges representing expenditure of $1,000,000 now under construction over the Cape Fear River at Wilmington, N. C., and a $25,000 causeway connecting them will shortly be completed and opened to traffic by the North Carolina Highway Department. The bridges total 2,190 and 1,520 ft. respectively. The northeast branch structure has a 185-ft. double-leaf deck girder bascule, two flanking spans 185 ft. in length, two 141-ft. spans and one 177-ft. span, all of the deck-truss type. Twenty-two 40-ft. spans and fifteen 20-ft. spans comprise the steel viaduct approach, which is supported by concrete pedestals and bents.

The bridge over the northwest branch or Cape Fear River proper has a 185-ft. double-leaf deck girder bascule and three deck-truss spans each 125 ft. in length. The approach for this bridge is of similar construction to that of the northeast bridge and contains eighteen 40-ft. and twelve 20-ft. spans. The causeway is constructed of sand dredged from the bottom of the river.

WASHINGTON NOTES

By PAUL WOOTON
Washington Correspondent

President's Program May Aid Flood-Control Work—Planning to Revise Public Contracts

IN AN EFFORT to co-operate with the President in the program for speeding up public work, the House flood-control committee will take up at an early date the flood-control projects throughout the country. This has been announced by Chairman Reid. The Army Engineers have been requested to send their reports to the committee on the various projects as fast as possible.

The flood-control operations under consideration include the Lake Okeechobee project in Florida, the St. Francis River in Arkansas and Missouri, the Alleghany and Monongahela rivers project at Pittsburgh, and protective work on the White and Arkansas rivers. Aid from the national government in the construction of flood-control works also has been requested by the states of Georgia, Texas, Alabama, Michigan, Pennsylvania, Kentucky, North Carolina, Kansas, Illinois, Oklahoma, South Dakota and Nebraska and by the New England states.

Mr. Reid believes an opportunity exists to make the flood-control work an effective part of the movement to stabilize business conditions. The present program for the work on the Mississippi, he points out, calls for the completion of the project in ten years with a total expenditure of $325,000,000. Since this is the largest government project under construction and since there is urgent need for the completion of the work at the earliest possible date, Mr. Reid believes that steps should be taken to speed up operations. Only $33,000,000 of the amount authorized has been spent to date. Many contractors throughout the Middle West have forces of workmen available which could be utilized on the Mississippi project, Mr. Reid points out. He also calls attention to the fact that plants turning out construction machinery and materials would be assured of additional outlets.

Protecting Lake Harbors

Additional funds have been made available by the War Department for speeding up the temporary repair work on the Milwaukee breakwater. During the severe storm of several weeks ago a 700-ft. section of the south breakwater was washed away. As a result of the failure of the foundation on the harbor side, which it is believed was caused by the absence of riprap, fourteen caissons were pushed from their support by the wave action and slid down the slope into the harbor. It is planned to rush the temporary repairs as much as possible so that a maximum of protection can be afforded before the winter season sets in.

As a result of the break, army engineers are now coming to the conviction that in many places along the Great Lakes riprap work on the harbor side of breakwaters is almost as essential as it is on the lake side. At Milwaukee there is a layer of riprap 3½ ft. thick on the lake side; it is now recommended that the layer be increased to a 6-ft. thickness at exposed points. It is also proposed to put in a riprap layer of 3½ ft. on the harbor side along the entire length of any section that is not now protected. This thickness would be increased at particularly dangerous points. The 40-ft. depth of the section of the harbor where the breakwater is constructed makes the wave action more destructive at Milwaukee than at most other lake harbors where shallower water is encountered, it is pointed out. Another point that has been raised is that the small stone foundation material used at Milwaukee makes riprap protection on the harbor side advisable.

Changes in Government Contracts

Since the regular session of Congress adjourned last spring the government departments have been reviewing the proposed redraft of the public contract act which has been prepared by Representative Crampton, of Michigan. The final recommendations have been made and have been embodied in the bill. The revised bill was introduced into the House Nov. 22 by Mr. Crampton and was referred to the judiciary committee.

The most controverted part of the bill is the section stating who shall be deemed responsible bidders. In the past, vigorous opposition has been encountered from the general accounting office over any attempt to vest department heads with the power to award bids to any other than the lowest bidder who can furnish a surety bond. It is now believed, however, that the difficulty has been eliminated and that the wording of the modified bill is acceptable to the Comptroller-General.

Under the section of the new bill dealing with awards, the following policy is pronounced: "Award shall be made . . . to that responsible bidder whose bid, conforming to the specifications, will be the most advantageous to the government, price and other factors considered; provided, that acceptance of any other than the lowest bid conforming to the specifications, or the rejection of any bid on the ground of the bidder's irresponsibility, shall be by the head of the department concerned, whose decision shall be final, and in such case he shall file with the original contract a statement of his reasons therefor, an abstract of all bids received and a copy of the advertisement; provided further, that all bids may be rejected when it is in the public interest so to do."

Another section of the bill in which it appears that the general accounting office has capitulated is in connection with the liquidation of damages. Disputes formerly arose in cases where department heads acted to relieve contractors of part or the whole of payments in contracts which provided for liquidated damages. Section 10 of the new act authorizes the department heads to make

remissions in such cases as they believe it is in the government's interest to do so, provided they state their reasons in writing.

Another section of the bill which has occasioned some dispute is that dealing with the use of domestic materials in public work. As the act has been revamped, it is written into the contract that domestic materials shall be used, conditions of quality and price, including duty, being equal. During prior discussions of the subject this favoritism of domestic materials was criticised on the ground that it would impose restrictions on contractors in making substitutions in the event that the domestic articles should become unobtainable after the contract had been made.

Personal Notes

GEORGE W. BOOTH, chief engineer of the committee on fire prevention and engineering standards of the National Board of Fire Underwriters, was honor guest at a testimonial dinner at the Drug and Chemical Club, New York, on Nov. 20. The dinner was given by the members of the Advisory Engineering Council, composed of the managers and other representatives of the underwriting boards and bureaus throughout the country.

CLYDE E. WALLINGSFORD has been appointed city manager of Springfield, Ohio, a position he has filled since the resignation of Robert W. Flack, who went to Durham, N. C., as city manager.

CHESTER C. FISHER, formerly with the U. S. Reclamation Service and for the past three years construction engineer to the Mexican government on irrigation service under the J. G. White Engineering Corporation, has accepted a position with the Russian government as consulting and construction engineer in irrigation work in Transcaucasia. His headquarters will be in Tiflis.

CARROLL R. HARDING, engineer of standards for the Southern Pacific Company, has been made assistant to the president.

ROSS K. TIFFANY and LARS LANGLOE announce the opening of an office as consulting hydraulic engineers in Olympia, Wash. They will specialize in hydro-electric development, municipal and industrial water supply and irrigation.

JAMES A. MEACHAM has been appointed engineer in charge of inspection and research for the H. K. Ferguson Company, Cleveland, Ohio. For the past three years he has been specification engineer for the company.

JEROME C. ZUFELT, of Sheboygan, Wis., who has been employed for the past four years by Consoer, Older & Quinlan, of Chicago, as assistant engineer of design and construction, has taken a position with the Jerry Donohue Engineering Company, of Sheboygan, his immediate assignment being supervision of the construction of the water-filtration plant being built for the city of Sheboygan.

HAROLD E. WESSMAN, formerly instructor of structural engineering at the University of Illinois, is now professor of bridge engineering at Nanyang University, Shanghai, China. The university is a government technical school under the control of the Ministry of Railways.

H. B. R. CRAIG, in charge of the London (Ont.) district of the Department of Public Works of Canada, has tendered his resignation, to take effect Dec. 31. Mr. Craig plans to open an office as consulting engineer, probably in London. He is a graduate of Queen's University and has been with the Department of Public Works for eighteen years.

Obituary

DAVID OGLE THOMAS, 53 years old, superintendent of the St. Clair County (Ill.) Highway Department, with headquarters at Belleville, Ill., died Nov. 24. Mr. Thomas was placed at the head of the county's highway department when it was formed in 1914 and had developed its roads intensively and systematically. More than 200 miles of hard roads were built under his direction. He was a graduate of Yale University and for some time was connected with the engineering department of the St. Louis & O'Fallon Railroad. He took a prominent part in the civic affairs of Belleville and St. Clair County and was vice-president of the Illinois Society of Engineers.

JOHN BRYANT TORBERT, expert on maps of the U. S. Geological Survey, died in Washington, D. C., on Dec. 1. He was 62 years old.

ARTHUR A. SANGSTER, contractor and engineer, associated with the firm of Larkin & Sangster, of Buffalo, N. Y., builders of the New York State Canal section through Seneca Falls, N. Y., died suddenly at his home in Houston, Tex., on Nov. 26.

BEN REYNOLDS, 76 years old, a pioneer railroad contractor, died recently in Ponca City, Okla. Mr. Reynolds assisted in the building of the first line of the Chicago, Rock Island & Pacific railroad system, the Chicago, Burlington & Quincy route into Denver, the White River Railroad in Arkansas, the double tracking of the Chesapeake & Ohio, the building of Mississippi River bridges at Dubuque, Iowa, Louisiana, Mo., and Minneapolis, Minn. His services also were employed in building bridges over the Missouri River at Glasgow, Mo., and Plattsmouth, Neb. He was instrumental in the construction of a railroad from Little Rock, Ark., to Camp Pike in three weeks soon after the entry of the United States into the World War.

EDMUND WRAGGE, internationally known consulting engineer, died in Toronto Nov. 26. He was 93 years old. Mr. Wragge was born in Worcestershire, England, and began his career as a pupil with Sir Charles Fox & Partners, of London. At the age of 22 he went to South Africa, where he built the first railway in that country, 40 miles of track between Cape Town and Stellenbosch. In 1862 he returned to England, and was intrusted with the construction of the Victoria bridge over the Thames. Going to Canada in 1869, he was appointed chief engineer in charge of the construction of the Toronto, Gray & Bruce and the Toronto & Nipissing railways, which were later absorbed by the Canadian Pacific and Grand Trunk railways. In 1883 he was appointed Toronto manager of the Grand Trunk system, retaining that position until 1896, when he again returned to England, spending the next four years in London building the terminals of the Great Central Railway on Marylebone road. Returning to Canada in 1904, he commenced the practice of his profession in Toronto, and was retained by the Canadian Pacific Railway as consulting engineer, retiring from active practice in 1914. Mr. Wragge was the oldest member of the Imperial Institute of Civil Engineers of London.

Society Calendar

AMERICAN CONCRETE INSTITUTE, Detroit; annual convention, New Orleans, La., Feb. 11-13.

AMERICAN CONSTRUCTION COUNCIL, New York City; annual meeting, Chicago, Ill., Dec. 12-14.

AMERICAN ROAD BUILDERS ASSOCIATION, Washington; annual convention, Atlantic City, N. J., Jan. 11-18.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; annual meeting, New York City, Jan. 15-17.

AMERICAN WOOD PRESERVERS ASSOCIATION, Chicago; annual meeting, Seattle, Wash., Jan. 28-30.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington; annual convention, New Orleans, La., Jan. 20-22.

ASSOCIATION OF HIGHWAY OFFICIALS OF NORTH ATLANTIC STATES, Trenton; annual convention, Syracuse, N. Y., Feb. 19-31.

NATIONAL CRUSHED STONE ASSOCIATION, Washington; annual convention, Cincinnati, Ohio, Jan. 20-23.

NATIONAL SAND AND GRAVEL ASSOCIATION, Washington; annual meeting, Memphis, Tenn., Jan. 28-30.

MISSOURI WATER AND SEWERAGE CONFERENCE at its recent annual meeting elected officers as follows: chairman, S. J. Duncan, Moberly; vice-chairman, J. H. Wells, Joplin; secretary, H. D. Peters, Jefferson City.

NATIONAL RIVERS AND HARBORS CONGRESS will be held in Washington, D. C., Dec. 10-11.

ST. LOUIS SECTION, American Society of Civil Engineers, on Nov. 25 elected the following officers: president, W. W. Horner; vice-presidents, F. W. Green and W. J. Burton; secretary-treasurer, R. A. Willis.

TENNESSEE SOCIETY OF ENGINEERS was organized Nov. 23 at a meeting in Nashville. Rutledge Smith, Nashville, was elected president; N. W. Dougherty, Knoxville, vice-president; F. B. Ragsdale, Memphis, secretary; and C. A. Betts, Chattanooga, treasurer.

Construction Equipment and Materials

Trade Commission Rulings Affect Two Industries

The Federal Trade Commission has approved eleven rules of business practice adopted by the manufacturers of concrete mixers and pavers and has accepted eight other rules adopted by the industry as expressions of the trade. Two of the latter group brand as bad business practices the renting of new concrete mixers and pavers by manufacturers and the furnishing of new concrete mixers or pavers "on trial" either with or without an order.

The commission has reconsidered its action of Sept. 18, 1929, in receiving rule 8 of group 2 as adopted at the trade standards conference for the reinforcing steel fabricating and distributing industry, and modified the rule to approve the practice of each individual member of the industry independently publishing and circulating to the purchasing trade his own price list.

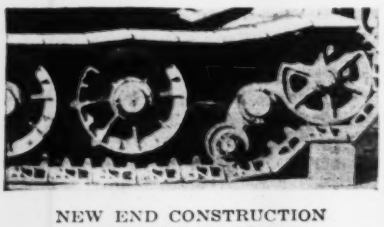
Portland Cement Association Elects Officers

The Portland Cement Association at its annual meeting Nov. 18-20 re-elected Frank H. Smith president. Mr. Smith is president of the Lawrence Portland Cement Company. William M. Kinney was re-elected secretary, George E. Warren assistant secretary, and F. L. Page assistant treasurer. C. E. Ulrickson, Trinity Portland Cement Company, was made treasurer.

New Developments

Crawler Tread Improved

Excavating equipment made by the Thew Shovel Company, Lorain, Ohio, can now be equipped with a new type of center-drive crawler in which the standard single end rollers are replaced by equalizer rocker arms mounted on the end axles. Each rocker arm carries both a large end roller and a small intermediate load-carrying roller. This mounting increases the over-all length of the crawlers from 12 to 29 per cent on the various units, resulting in greater supporting area and the consequent reduction in ground pressures of from 15 to 25 per cent. In addition to these advantages, the tendency to dig in is eliminated, for any tipping load thrown on the end axle is transmitted through the rocker arm and its two rollers and is distributed over an increased area of several treads. The load is so proportioned that the greater amount goes to the smaller rear roller, giving the large front-end roller a tendency to climb out of soft material. The propelling force, as before, is applied through the center of the tread by the Thew center-drive principle.



NEW END CONSTRUCTION OF CRAWLER TREAD

Rocker arm equipment can be fitted to the Lorain ¾-, 1- and 1¼-cu.yd. shovels, cranes, clamshells, draglines and back diggers. For shovel use, when it is desirable to keep the shorter standard end of the crawler facing into the bank, equalizer rocker arms may be added at the rear of the crawler only.

High-Speed Snow Plow Attachment for Ford Trucks

Attachment to the truck frame in the rear is provided for in the design of a new one-way snow plow known as model 23 developed by the Baker Manufacturing Company, Springfield, Ill., for attachment to model AA Ford trucks. This is intended for operation in moderate snows at speeds up to 30 miles an hour. The plow is clamped to the truck by means of an underslung push frame held by clamps to the truck channels at the rear and supported in front by means of two bolts through the holes supporting the front bumper, which is removed. The lifting frame is bolted to the end of these channels, while the plow push members pivot on an axle through the front end of the underslung frame. The moldboard, of ⅜-in. boiler-plate steel, is 8 ft. long, 21 in. high at the forward end and 30 in. high at the rear end. Tripping blades are made in two sections, each 3½ ft. long, and are connected to springs which take the shock when striking an obstruction.

LIGHT SNOW PLOW FOR FORD TRUCKS

Parallel-Jaw Pliers of New Type

Use of a cam, a fulcrum and a wedge are the principles about which are designed a new type of parallel-jaw pliers developed by the Kant Slip Plier & Tool Company, Chicago, Ill. The center pin, which usually carries all the strain in a tool of this type, is used solely for the purpose of holding the two members together. Gripping action is produced by a sliding fulcrum at the base of one jaw, in combination with a sliding cam, the combination serving to wedge the object gripped between the two jaws. The position of the fulcrum near the load adds to the gripping power of the tool. A special formula alloy chrome vanadium steel is used as material. This is hardened throughout, not casehardened. The teeth in the jaws are machined accurately and will not batter or crumble. The tool is made in the 8-in. size, and will soon be produced in 6-, 10- and 12-in. sizes also.

PLIERS OPERATE ON CAM AND FULCRUM PRINCIPLE

Business Notes

HERCULES POWDER COMPANY, Wilmington, Del., has appointed R. B. McKinney assistant to the general manager of its explosives department. Mr. McKinney, who was formerly director of purchases, will be succeeded in that post by F. P. H. Sholly.

HARDINGE COMPANY, York, Pa., has appointed Howard G. Wright, formerly chief engineer of the North American Cement Company, Catskill, N. Y., research engineer in its cement machinery department. John L. Mason, formerly sanitary engineer for the Water Works Supply Company, San Francisco, Calif., has become sewage research engineer for the Hardinge Company.

GENERAL ELECTRICA ESPANOLA has been formed to exploit in Spain and Spanish colonies the patents of the International General Electric, New York, Société Generale de Constructions Electrique et Mechaniques Als-Thom, Paris, and the Sociedad Iberica de Construcciones Electricas, of Spain. The new company will command the technical assistance of the parent companies and will have exclusive rights to the manufacture and sale of their products for the electrification of Spanish railways and other projects. Sociedad Espanola de Construcciones Babcock and Wilcox, Sociedad Colectiva Sota y Aznar and the Banco de Vizcaya also are represented in the international combination.

HEADLEY EMULSIFIED PRODUCTS COMPANY, Philadelphia, Pa., is the successor to Headley Good Roads Company, manufacturer of emulsified asphalt products. The new company will extend its line to cover further industrial uses. Branch offices in charge of resident engineers will be opened in a number of cities and distributors with warehouse stocks are to be appointed in leading industrial centers. Further manufacturing facilities are also planned. New officers are as follows: president, Edgar S. Ross, director of research and development of the old company and formerly in charge of investigations on roofings and waterproofings at the Mellon Institute of Industrial Research; vice-president, Parmely W. Herrick, of the Herrick Company, Cleveland, Ohio; vice-president and treasurer, M. W. Lefever, for fifteen years in a similar position with the Headley Good Roads Company; secretary, George D. Webster.

The Business Side of Construction

Seasonal Decline Seen in November Construction Work

OCTOBER was the first month this year to show an important drop in contract letting. In the last fifteen years the October volume declined eight times and rose six. This year's drop would therefore not be particularly significant had not engineering construction remained on so high and firm a level throughout the year. The drop was 25 per cent, and November shows a further decline of 10 per cent. This also is seasonal, the average decline for this month being 16 per cent.

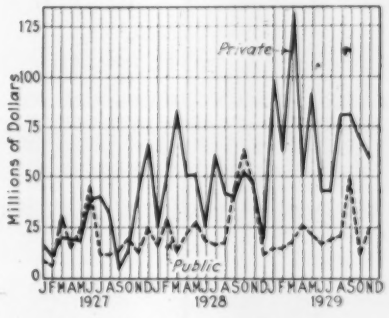
The weekly average for November was 59.5 millions, compared with 66 in October, 61 a year ago and 81 for the whole of 1929. The averages for 1928 and 1927 were 69 and 60. Thus, although there has been a definite drop from the larger values of the first nine months, the values for the last two months may be regarded as normal for the season. Total engineering construction is 13.5 per cent higher than it was in 1928 and 33 per cent above 1927. As was the case last year, most of the increase has been in New York, and the trend here is shown in the accompanying chart for the last three years.

October was distinguished by three outstanding contracts of $20,000,000, $25,000,000 and $30,000,000. The November characteristic, the same as a year ago, was many large though not unusually large contracts. Forty-four contracts averaged $2,400,000; in November, 1928, thirty contracts averaged $3,200,000. Last month the largest 6 contracts in millions were: two offices in New York, 10 and 9; subways in Brooklyn and Long Island City, 9 and 3; office in St. Louis, 5.5; aviation plant in Los Angeles, 10.5. The largest contracts a year ago were a hydro-electric development in Missouri for 16.7, and a factory in Baltimore for 15.

Residential building for the first nineteen business days of November averaged $3,995,000 per day, compared with $5,296,000 in October.

Financing in October

New capital for corporation purposes issued in October amounted to $576,000,000, compared with $554,000,000 in 1928. This increase is easily cancelled as far as construction is concerned by the fact that $200,000,000, or 35 per cent, of the October figure is for investment trusts and holding companies. For the ten months the total is $7,547,000,000, compared with $3,755,000,000



CONTRACT LETTINGS IN NEW YORK STATE

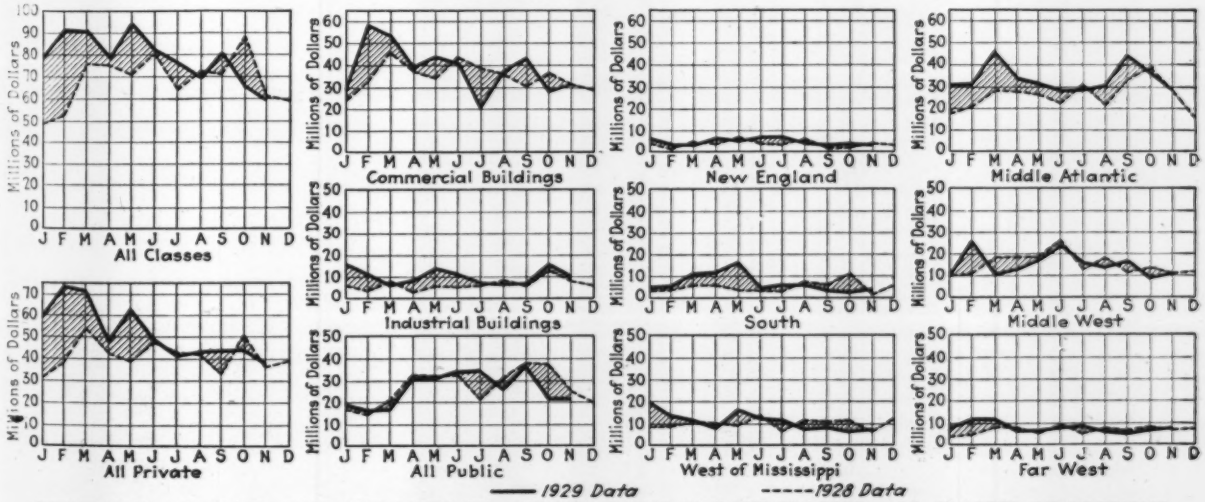
Large N. Y. Contracts Included in Statistics

1927	
June, public, subway	$22,282,309
July, private, depot	12,000,000
Nov., private, 3 bldgs.	13,500,000
1928	
Sept., public, subways	21,451,979
Oct., public, water tunnel	42,692,568
1929	
Jan., private, oil refinery	45,000,000
March, private, hotel	40,000,000
March, private, office	20,000,000
Aug., private, office	50,000,000
Sept., private, office	25,000,000
Sept., private, subway	4,882,705

VALUE OF CONTRACTS AWARDED IN THE UNITED STATES AND TOTAL FOR CANADA, NOVEMBER, 1929

Thousands of Dollars (000 omitted)

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States November 1929	United States Year to Date 1929	United States Year to Date 1928	Canada November 1929
Water-works	$31	$2,079	$96	$693	$385	$750	$4,034	$45,394	$91,473	$21
Sewers	589	706	293	1,919	1,700	359	5,566	83,471	94,636	
Bridges	172	1,635	1,265	1,011	2,868	1,350	8,301	129,175	119,552	
Excavations, etc.	113	15	302	327	496	272	1,525	27,376	32,968	462
Streets and roads	491	6,424	4,066	5,262	7,368	4,633	28,244	515,759	592,128	239
Industrial buildings	3,985	6,493	8,480	6,890	2,243	11,565	39,656	521,500	330,272	200
Commercial buildings	7,659	74,372	2,372	22,898	11,638	6,824	125,763	1,901,342	1,741,146	3,115
Federal government	11	2,812	179	285	529	259	4,075	100,870	66,325	
Unclassified	757	13,998	257	2,496	2,472	524	20,504	464,220	272,988	4,816
November, 1929, 4 weeks	13,808	108,534	17,310	41,781	29,699	26,536	237,668			8,853
October, 1929, 5 weeks	18,639	179,936	14,429	45,199	36,433	35,298	329,934			10,291
November, 1928, 5 weeks	19,947	147,593	17,984	53,751	36,245	30,509	306,029			22,682
Year to date, 1929	220,985	1,612,577	323,129	726,443	548,571	357,402		3,789,107		175,678
Year to date, 1928	208,969	1,316,471	266,474	758,253	484,183	307,138			3,341,488	154,735



CONTRACTS AWARDED—AVERAGE WEEK PER MONTH—TOTAL U. S. BY CLASSES—ALL CLASSES BY SECTIONS

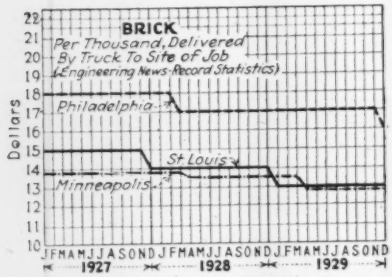
in 1928. Investment trust financing in this period amounts to 32 per cent, compared with 20 to 22 per cent the year before.

Long-term public financing in October totaled $114,000,000, compared with $99,000,000 a year ago. For ten months the total is $1,038,000,000, compared with $1,050,000,000 in 1928. The October total included $30,000,000 Port of New York Authority 4½ per cent bridge construction bonds at 92.857, net interest cost 4.896 per cent. In addition, there were fifteen issues exceeding $1,000,000 and aggregating $39,000,000.

On Dec. 2 Boston received bids on $4,609,000 4¼ per cent bonds, including $1,000,000 for sewers, $700,000 for highways, $360,000 for sewage and $100,000 for an airport. Detroit receives bids Dec. 5 on $24,266,000 for water supply, school, sewer and airport construction. Milwaukee County receives bids Dec. 19 for $2,000,000 4¼ per cent courthouse bonds. Mobile County (Ala.) receives bids Dec. 16 for $3,325,000 road and bridge bonds.

Cement Prices Recover; Other Materials Lower

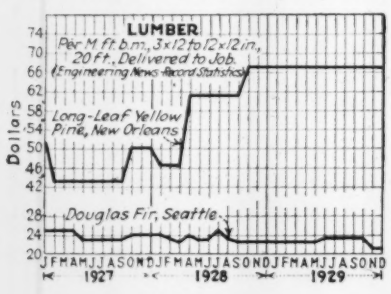
The general price level of building materials was lowered during the month, due chiefly to weakness in brick and lumber prices. Steel remains steady, with no prospect of advancing, while cement has recovered the early autumn

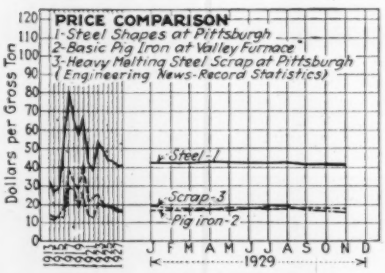

BRICK
Per Thousand, Delivered By Truck To Site of Job
(Engineering News-Record Statistics)
Philadelphia
St Louis
Minneapolis
Dollars
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1927
1928
1929

price drop. Prices of cast-iron pipe, wire nails, scrap and minor materials also are declining.

Buying is more than seasonally slow, yet dealers report a comparatively small volume of cancellations or postponements. Collections are slow.

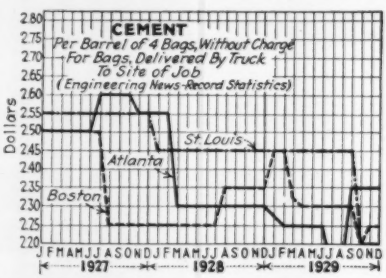
Brick—This market is depressed, with sales half those of a year ago. Where orders for 210,000,000 brick a month were recorded for the country last year at this time, the present volume is 110,000,000. The situation in New York City is typical. All open yards are out


LUMBER
Per M ft. b.m., 3x12 to 12x12 in., 20 ft., Delivered to Job
(Engineering News-Record Statistics)
Long-Leaf Yellow Pine, New Orleans
Douglas Fir, Seattle
Dollars
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1927
1928
1929



of business in this district. The remaining plants are suited to all-year operation combined with rail delivery. Only two plants are actively producing.

A year ago there was a comparatively large number of bargeloads of brick at New York docks, covered for winter storage, but there is none now. The books of a leading wholesale firm of the city illustrate present market conditions.

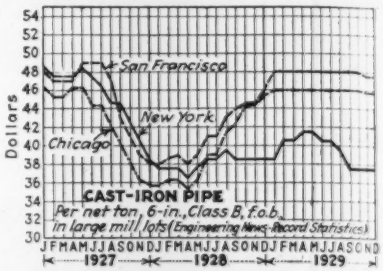

CEMENT
Per Barrel of 4 Bags, Without Charge For Bags, Delivered By Truck To Site of Job
(Engineering News-Record Statistics)
St Louis
Atlanta
Boston
Dollars
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1927
1928
1929

The records show two bargeloads held over from last month, against 26 a year ago. This does not indicate a demand so good that all but two were sold; it means that two were sufficient to supply first-of-the-month requirements of the trade.

Average delivered prices in 21 cities are: Dec. 1, $14.63; Nov. 1, $14.75; Dec. 1, 1928, $14.92.

Lumber — Producers are concerned mainly with holding production and stocks to a point where prices will not break. At present there is less lumber being sold than at any time since the beginning of the year. All sections of the country report unusually slack business in lumber, with outlook for recovery best in Southern pine and Northern hardwood.

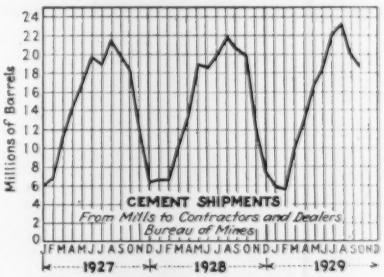
Dealers' stocks, though not heavy, have increased and there is constant pressure by wholesalers to enlarge them.


San Francisco
New York
Chicago
CAST-IRON PIPE
Per net ton, 6-in., Class B, f.o.b. in large mill lots (Engineering News-Record Statistics)
Dollars
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1927
1928
1929

Railway lumber is the only active material in the market.

Reserve stocks per mill average 7,700,000 ft., against 7,000,000 ft. a year ago. This is not considered excessive, since last year's reserves were fairly moderate. Mid-Western stocks are heaviest, but are well distributed as to grade.

The weekly cut averages 586,000 ft. per mill, compared with 641,000 last year. Current production is 31 per cent greater than demand, while a year ago

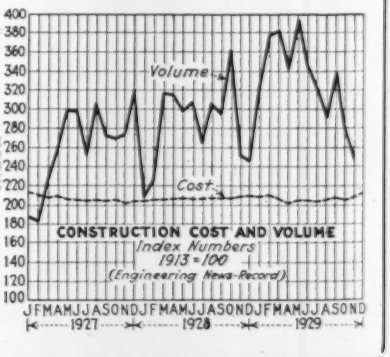

CEMENT SHIPMENTS
From Mills to Contractors and Dealers, Bureau of Mines
Millions of Barrels
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1927
1928
1929

Construction Cost and Volume Index Numbers

E. N.-R. Cost		F. N.-R. Volume*	
Dec., 1929	**209.46**	**Nov., 1929**	**245**
Nov., 1929	208.46	Oct., 1929	273
Dec., 1928	210.16	Nov., 1928	251
Peak June, 1920	273.80	1928 (average)	287
1928 (average)	206.78	1927 (average)	263
1913 (average)	100.00		
1928		1928	
January	203.90	January	208
February	204.65	February	225
March	204.65	March	318
April	206.40	April	316
May	207.00	May	299
June	206.15	June	308
July	206.65	July	266
August	207.29	August	306
September	207.29	September	296
October	207.71	October	363
November	209.46	November	251
December	210.16	December	244
1929		1929	
January	209.46	January	325
February	210.40	February	378
March	207.78	March	382
April	203.40	April	332
May	205.15	May	395
June	205.65	June	347
July	204.77	July	320
August	205.91	August	290
September	207.57	September	340
October	206.32	October	273
November	209.46	November	245

*Corrected for price change since 1913.

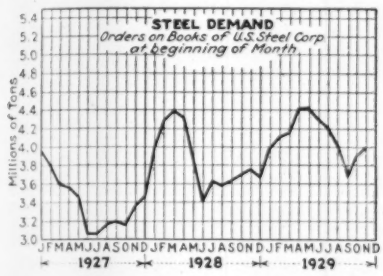
Materials prices throughout country are tending down very gradually. The 1 point increase in general costs is due to higher labor rates. The 9 per cent drop in volume is seasonal, the year-ago drop being 31 per cent. Total to date is 13 per cent above 1928.


Volume
Cost
CONSTRUCTION COST AND VOLUME
Index Numbers
1913 = 100
(Engineering News-Record)
Index
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1927
1928
1929

the margin was 22 per cent. Cutting, at times, may normally get ahead of selling, but at present it is far enough ahead to benefit the buyer.

Average delivered prices of 3x12's in 21 cities are: Pine—Dec. 1, $64.74; Nov. 1, $64.82; Dec. 1, 1928, $58.79 per 1,000 ft.b.m.; Fir — Dec. 1, $51.18; Nov. 1, $51.42; Dec. 1, 1928, $45.76 per 1,000 ft.

Steel—Steel operations last week were at 69 per cent, compared with 83 last year. Shape mills are booked three to four months ahead. Prices are $1.90, Pittsburgh, the same as since October and the same as a year ago. Prices of wire nails and all scrap are lower. Buying of reinforcing bars is normally low this season, but shipments are active on old orders. Much plate tonnage is expected soon from the railroads.



Cement—On Nov. 25 the cement industry recovered its price declines of early fall in a rise of 20 to 30c. per barrel in Northern mills and 10 to 50c. at Southern plants. The increase was not based on prospective business, but was an effort to set a profitable price.

The statistical position of the industry is hardly favorable. While 11 per cent more cement is being sold than is produced, the difference a year ago was 13 per cent, and mill stocks (15,300,000 bbl.) are 5.5 per cent heavier.

The average mill price Dec. 1 was $1.69; Nov. 1, $1.63; Dec. 1, 1928, $1.80.

Cast-Iron Pipe—The mill base at Burlington is off $1 per ton, to $34. This has lowered the New York price $1, to $36.30. Buying, even of small lots, has been slackening for several weeks.

Cement Imports and Exports

Cement imports to the United States in the first eight months of this year totaled 1,714,470 bbl. Belgium is the heaviest shipper, with 866,732 bbl. going to fifteen American ports and to Porto Rico and Hawaii. Los Angeles received 296,000 bbl., Massachusetts 202,000 and New York 68,000.

Denmark is the heaviest shipper to Porto Rico, with 186,000 bbl.; it also sent 74,600 to New York. The United Kingdom contributed 86,000 bbl. to New York's foreign cement receipts.

United States exports in the same period totaled 558,091 bbl. Of these the United Kingdom received 21,000 and Germany 2,400, the other European countries taking less than 1,000 each. Mexico received 84,000 bbl., Cuba 79,000, Panama 61,000 and Canada 43,000. Venezuela took 71,000, Argentina 40,000, Colombia 20,000 and Chile 19,000. Shipments to Asia totaled only 9,308 bbl., and to Oceania 5,232.

Domestic production in the first eight months totaled 111,000,000 bbl. The total for ten months is 144,896,000 bbl.

Quiet Labor Situation

Because of the decline this year in residential construction, unemployment in the building trades has been considerably greater and has been increasing. To stem this trend and to start it upward, as well as to maintain industrial production, is part of the programs of the various business conferences called by the President. The nation-wide plan to keep construction at its normal expenditure level of nine or ten billions in 1930 is expected to perform the desired function of maintaining mass consumption.

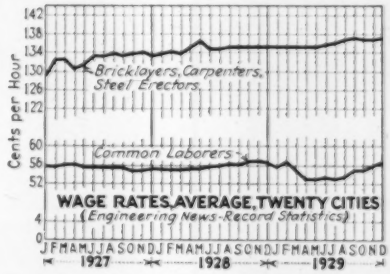
Local conditions:

New York City—Members of the International Subway, Tunnel and Compressed Air Workers Union threaten general strike of laborers, shorers, blasters and timbermen, in all 15,000 men, on subway construction work, unless higher wage demands are granted by the contractors.

Newark — Structural ironworkers, bricklayers and hoisting engineers walked out on a local project as result of dispute over introduction of out-of-town mechanics.

Baltimore — Recently formed Independent Carpenters Union declares for the former 5½-day week. This union is not affiliated with the carpenters' national organization nor with the American Federation of Labor.

Chicago — Journeymen lathers, 1,500 men, returned to work Nov. 7 after a short lockout by the employing plasterers. The union concedes right of employers to name foremen on plastering jobs. Bridge, structural and ornamental ironworkers will demand an increase of $2 per day, to $12, Feb. 1. The Chicago Association of Commerce repeats indorsement of the Landis



award of 1921 as a means of strengthening the employers' position in the present depressed building situation.

Dallas—Bricklayers granted five-day week and 12½c. per hour (to $1.75) Dec. 1. Carpenters to receive similar rate Jan. 1. It is expected that by March, 1930, all other building trades will have the shorter week with increase of 12½c. per hour.

Wages in Canada—A recent survey of wages in the building trades by the Canadian Construction Association, Ottawa, shows bricklayers' rates ranging from $0.90 to $1 in Sault Ste. Marie, Halifax, Quebec, Belleville, Cobourg, Stafford, to $1.45 in Windsor, Brandon, Winnipeg, Prince Albert, Regina, Saskatoon, Lethbridge, Calgary and Edmonton. Plasterers' rates vary from $0.80 in Sherbrooke to $1.50 at Edmonton. Structural steel workers receive $0.65 in Quebec and $1.12½ in Vancouver. Common labor averages $0.40.

In Montreal plasterers' wages have been fixed at $1.05 per hour to Sept. 30, 1930, by an arbiter acting in the dispute between master plasterers and journeymen. The workmen were receiving $1.15 per hour and demanded $1.25. It was found in the arbitration proceedings that one local was receiving $1.15, while the majority of the plasterers in the city were working at a lower rate.

Skilled building trades mechanics receive an average rate of $1.37 per hour, compared with $1.36⅜ in November and $1.35⅛ in December, 1928. The skilled rate in manufacturing is 67½c. Common laborers average 56.53c. per hour, compared with 56.03c. in November and 56.28c. in December, 1928. The average unskilled rate in manufacturing is 50.6c.

CURRENT BUILDING AND CONSTRUCTION TRADES WAGE RATES* PER HOUR

Advances since last month are indicated by **heavy type**; declines by *italics*

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor*
Atlanta	$1.25@1.40	$0.60@.70	$0.60@1.00	$0.50	.....	$0.75@1.25	$0.25@.35
Baltimore	1.75	1.00@1.10	1.00@1.37½	.65	$1.00	1.00@1.25	.35
Birmingham	1.50	1.00	1.25	.50	.....	1.25	.20 @ .35
Boston	1.50	1.37½	1.37½	.85	1.27½	1.37½	.45 @ .80
Cincinnati	1.62½	1.40	1.40	1.00	1.40	1.40	.40 @ .60
Chicago	1.70	1.62½	1.62½	.97½	1.62½	1.62½	.97½
Cleveland	1.62½	1.37½	1.37½	.87½	1.10	1.50	.40@.87½
Dallas	**1.75**	1.12½	1.25	.40 @ .75	1.25	1.25	.35@.50
Denver	1.50@1.62½	1.25	1.25@1.37½	.87½@1.00	.....	1.25	.62½
Detroit	1.56½	1.00@1.25	1.00@1.10	.90	1.00@1.10	1.00@1.25	.37½@.60
Kansas City	1.50	1.25	1.25	.90	1.25	1.25	**.40**@.75
Los Angeles	1.25	1.00	1.00	.....	.....	1.00	.50
Minneapolis	1.25@1.37½	.87½@.95	.87½	.75	.....	1.00	.40@.60
Montreal	1.25	.80	.75	.....	.90	1.00	.35
New Orleans	1.50	.90	1.25	.75	.80@1.00	1.25	.30@.40
New York	1.87½	1.65	1.92½	1.18¾	1.10@1.23¾	1.92½	1.03¼
Philadelphia	**1.75**	1.12½@1.25	1.02½	.70@1.12½	1.00	1.37½@1.50	.45@.50
Pittsburgh	1.70	1.50	1.43¾@1.56¼	1.12½	.....	1.50	.40@.80
St. Louis	1.75	1.50	1.50 @1.65	1.15@1.25	1.25	1.62½	**.50**@.87½
San Francisco	1.37½	1.12½	1.12½	.87½	1.12½	1.37½	.68¾
Seattle	1.50	1.12½	1.12½@1.25	1.00	1.12½	1.25	.70

*Minimum rates are for construction other than buildings, non-union.

Current Prices of Construction Materials

Price advances since last month are indicated by **heavy type**; declines by *italics*

Building Materials

PORTLAND CEMENT—Prices per barrel, *without charge for bags*, cash discount not deduct d. Prices marked f.o.b. are manufacturers'; others are delivered by truck to contractors:

	Dec. 5, 1929	One Month Ago	One Year Ago
Atlanta	$2.35	$2.35	$2.10
Baltimore	2.40	2.40	2.65
Birmingham	2.40	2.40	2.60
Boston	2.25	2.25	2.35
Cedar Rapids (f. o. b.)	2.04	2.04	2.24
Chicago (f. o. b.)	1.85	1.85	2.05
Cincinnati (f. o. b.)	1.92	1.92	2.22
Cleveland (f. o. b.)	1.94	1.94	2.24
Dallas	2.15	2.15	2.15
Davenport (f. o. b.)	2.04	2.04	2.24
Denver	2.61	2.61	2.55
Detroit (f. o. b.)	1.95	1.95	1.95
Duluth (f. o. b.)	1.84	1.84	2.04
Indianapolis, (f. o. b.)	1.89	1.89	2.19
Jersey City	2.60	2.60	2.35
Kansas City, Mo.	2.65	2.65	2.20
Los Angeles	2.42	2.42	2.66
Milwaukee (f. o. b.)	2.00	2.00	2.20
Minneapolis (f. o. b.)	2.02	2.02	2.22
Montreal (f. o. b.)	2.05	2.05	1.41
New Orleans	2.65	2.65	2.35
New York	**2.30**	2.10	2.25@2.35
Peoria (f. o. b.)	2.02	2.02	2.22
Philadelphia	2.10	2.10	2.41
Pittsburgh (f. o. b.)	1.85	1.85	2.04
St. Louis	2.20	2.20	2.45
St. Paul (f. o. b.)	2.02	2.02	2.22
San Francisco	**2.54**	2.40	2.41
Seattle	2.70	2.70	2.70
Toledo (f. o. b.)	2.03	2.03	2.20

Current mill-prices per barrel, in carloads, without bags, f.o.b.:

Alpena, Mich.	$1.65	Limedale, Ind.	$1.60
Buffington, Ind.	1.60	Mason City, Ia.	1.60
Hannibal, Mo.	1.80	Norfolk, Va.	1.90
Houston, Tex.	1.95	North Birmingham, Ala.	**1.70**
Hudson, N. Y.	1.55	Richard City, Tenn.	**2.05**
Ironton, Ohio	1.50	Steelton, Minn.	1.65
Iola, Kan.	1.65	Universal, Pa.	1.60
La Salle, Ill.	1.70	Wyandotte, Mich.	1.70
Lehigh Valley District	**1.75**		

SAND AND GRAVEL—Per cu.yd., delivered by dealers. Weight of sand, 1½ tons per cu.yd.; gravel, 1½ tons per cu.yd., unless otherwise specified in pounds:

	Gravel 1½ In.	Gravel ¾ In.	Sand
Atlanta, per ton	$2.65	$2.65	$2.00
Baltimore, per ton	2.40	2.60	1.70
Birmingham (2,600 lb. per cu.yd.)	3.00	3.00	2.65
Boston, per ton	1.90	1.90	1.25
Chicago	1.90	1.90	1.80
Cincinnati, per ton	1.65	1.65	1.40
Cleveland (3,000 lb.) (2,700 lb.)	2.60	2.60	2.50
Dallas	**2.60**	**2.60**	**2.60**
Denver (2,700 lb. per cu.yd.)	1.80	1.80	1.30
Detroit (2,600 lb. per cu.yd.)	3.25	3.25	2.75
Kansas City, Mo.	1.85	1.85	1.85
Los Angeles, per ton	2.15	2.15	1.30
Minneapolis (2,800 lb.) (3,000 lb.)	2.40	2.40	1.10
Montreal, per ton	1.25	1.25	1.25
New Orleans (2,700 lb.) (2,500 lb.)	3.75	3.75	2.75
New York	**3.40**	**3.40**	**2.15**
Philadelphia, per ton	2.30@3.15	2.30@3.15	1.50@2.31
Pittsburgh, per ton	2.20	2.20	2.40
St. Louis, per ton	2.25	2.25	2.00
San Francisco, per ton	1.75	1.75	1.75
Seattle (3,200 lb.) (2,850 lb.)	1.75	1.75	1.75

Note: New York gravel weighs 2,800@3,000 lb. and sand, 2,700 lb.

CRUSHED STONE—Per cu.yd., delivered by dealers. Weight, 1½ tons per cu. yd., unless otherwise specified in pounds:

	1½ In.	¾ In.
Atlanta, per ton	$2.65	$2.65
Baltimore, per ton	2.75	2.85
Birmingham, Limestone	3.00	3.25
Boston, per ton	2.25	2.25
Chicago, Limestone (2,500 lb. per cu.yd.)	1.90	1.90
Cincinnati, per ton	2.25	2.25
Cleveland, per ton (2,500 lb. per cu.yd.)	2.70	2.70
Dallas (2,500 lb. per cu.yd.)	3.25	3.40
Denver, Granite (2,700 lb. per cu.yd.)	2.50	2.50
Detroit, Limestone, per ton (2,500 lb. per cu.yd.)	3.00	3.00
Kansas City, Limestone	1.85	1.85
Los Angeles, per ton	2.15	2.15
Minneapolis, Limestone (2,600 lb. per cu.yd.)	2.40	2.40
Montreal, per ton	1.90	2.10
New York, Limestone	**3.40**	**3.40**
Philadelphia, Limestone, per ton	2.30@3.15	2.30@3.15
Pittsburgh, per ton	2.75	2.75
St. Louis, per ton, (2,400 lb. per cu.yd.)	1.90	1.90
San Francisco, Trap rock, per ton	1.65	1.65
Seattle, (2,700 lb. per cu.yd.)	1.90	1.90

CRUSHED SLAG—Manufacturers' quotations on crushed slag in carloads, per net ton, at plant:

	1½-In.	¾-In.	Roofing	Sand
Birmingham, Ala.	$0.90	$1.15	$2.05	$0.55
Buffalo District	1.25	1.35	2.25	1.25
Cleveland, Ohio	1.15	1.15	.....	.80
Eastern Pa. and Northern N. J.	1.25	1.25	2.00	1.25
Toledo, Ohio	1.25	1.25	1.50	1.25
Western Pennsylvania	1.25	1.25	2.00	1.25
Youngstown District	1.30	1.40	2.00	1.30

HOLLOW TILE—Building tile per block, delivered by dealers to contractors in lots of 2,000 pieces or over:

	4x12x12	6x12x12	8x12x12	10x12x12	12x12x12
Atlanta	$0.072	$0.099	$0.135	$0.181	$0.202
Baltimore	.105	.....	.20	.....	.26
Birmingham	.09	.127	.174	.218	.261
Boston	.086	*.113*	.155	**.70**	.26
Chicago	.076	.104	.142	.182	.242
Cincinnati	.066	.09	.125	.16	.18
Cleveland	.064	.088	.128	.171	.19
Dallas	*.094*	**.124**	**.134**	.271	.306
Denver	.0975	.135	.175	.2125	.25
Detroit	.098	.135	.184	.24	.265
Kansas City	.0525	.077	.184	.24	.265
Los Angeles	.085	.122	.175	.232	.285
Minneapolis	.0611	.081	.10605	.1302	.1737
Montreal	.12*	.....	.22†	.....	.....
New Orleans	.086	.118	.16	.212	.256
New York	.0864	.1296	.162	.....	.....
Perth Amboy, N.J. (f.o.b.)	.....	.....	.....	.2388	.2956
Philadelphia	.105	.14	.215	.28	.34
Pittsburgh	.068	.....	.1175	.....	.1726
St. Louis	.078	.104	.145	.175	.21
San Francisco	.108	.156	.255	.....	.....
Seattle	.085	.115	.18	.....	.....

*4x4x12. †8x8x12.

BRICK—Prices delivered by dealers per thousand, are as follows:

	Common	Paving 3x8½x4-in.	Paving 3½x8½x4-in.
Atlanta	$13.50	*$36.00**	*$42.00†*
Baltimore	*13.00*	40.00	46.00
Birmingham	15.00	*28.00**	*30.00†*
Boston	*16.00*	*43.00*	48.00
Chicago	12.00	42.00	45.00
Cincinnati	18.00	40.00	45.00
Cleveland	14@16	33.00	36.00
Dallas	*13.50*	*30.00*	.....
Denver	11.00	.....	.....
Detroit	15.50	34.50	38.50
Kansas City	14.50	.....	.....
Los Angeles	13.00	.....	.....
Minneapolis	12.75	.....	.....
Montreal	20.00	.....	.....
New Orleans	16.50	*38.00**	*42.00†*
New York	14@15	45.00	51.00
Philadelphia	16.00	40.00	46.00
Pittsburgh	16.00	40.50	45.00
St. Louis	13.00	36.00	40.00
San Francisco	14.50	45.00*	.....
Seattle	14.00	50.00	55.00

*2½x8½x4 in. †3x8½x4.

LIME—Prices delivered by dealers to job:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	Lump, per Barrel Common
Atlanta	$21.00	$13.50	.....	.....
Baltimore	22.00	14.00	$2.55†	.....
Birmingham	22.00	16.00	3.00†	$2.00†
Boston	22.00	**15.00**	4.00*	3.00*
Chicago	18.00	14.00	18.00‡	1.35†
Cincinnati	15.30	12.70	.....	.....
Cleveland	16.00	12.00	2.50†	2.50†
Dallas	20.00	.....	.....	18.00‡
Denver	32.00	23.75	3.80*	3.00*
Detroit	19.20	14.80	2.20†	2.20†
Kansas City	16.00	12.50	2.75†	2.40†
Los Angeles	25.00	18.00	2.85†	17.00‡
Minneapolis	25.50	21.00	.....	1.70†
Montreal	19.75	.....	.....	15.00‡
New Orleans	.....	.....	2.60†	1.60†
New York	21@23	14@15	4.10@4.20	3.15@3.25*
Philadelphia	22.00	15.00	.....	.....
Pittsburgh	21.00	19.00	2.50†	.....
St. Louis	24.00	18.00	2.75†	15.00‡
San Francisco	27.50	20.00	2.00†	1.70†
Seattle, paper sacks	36.00	24.00	.....	2.80†

*Per 280-lb. bbl. (net). †Per 180-lb. (net). ‡Per ton.

CONCRETE BLOCKS—Manufacturers' quotations on standard, 8x8x16-in., hollow, delivered to job, each:

Boston	$0.17@.20	Minneapolis	$0.15
Brooklyn and Queens	.12@.14	New Orleans	.22
Cleveland	.16@.17	Philadelphia	.18@.25
Denver	.22	Pittsburgh	.20
Detroit	.15	St. Louis	.18

SLATE—Roofing, f.o.b., quarry, Bangor, Pa., net, per square:

No. 1 Clear	$10.50@$14.50
No. 1 Ribbon	9.00@10.25
Medium Clear	9.50@11.25

Road and Paving Materials

PAVING STONE—Carloads or cargo lots of granite blocks, 4x8x4-in., dressed, f.o.b:

Atlanta	$3.00 per sq.yd
Baltimore	3.00 per sq.yd.
Boston	135.00 per M
Chicago, 5 in.	3.25@3.90 per sq.yd.
Cincinnati	110.00 per M
Cleveland	115@120 per M
Detroit, 5 in.	3.00 per sq.yd.
Kansas City	3.00 per sq.yd.
Minneapolis, 4½x8x5 in	2.80 per sq.yd.
Montreal	104.75 per M
New Orleans	2.80 per sq.yd.
New York, 5 in., Grade 1, 30 blocks per sq.yd	150.00 per M
Philadelphia	125.00 per M
St. Louis, 4x5x8 to 12 in.	3.50 per sq.yd
San Francisco	.....

Current Prices of Construction Materials

Road and Paving Materials—Continued

WOOD-BLOCK PAVING—Prices, f.o.b., in carloads:

	Size of Block	Treatment	Per Sq.Yd.
Atlanta	3½	16	$2.25
Boston	3½	16	2.25
Chicago	3½	12	2.10
Cincinnati	3½	16	2.35
Dallas	3½	18	3.90
Kansas City	3½	16	2.75
Minneapolis	3½	16	2.75
Montreal	4	16	4.50
New Orleans	3½	16	2.50
New York	3½	16	2.70
St. Louis	3½	16	2.30

FLAGGING—Alongside dock, New York: Manhattan and Bronx, 4 ft. wide, 24c. per sq.ft.; Queens, 5 ft. wide, 26c. per sq.ft.

CURBING—*New York*: Bluestone, f.o.b. barge, 5x16 in., rough, 90c. per lin. ft., cutting charges extra. *Birmingham*: Limestone, 5x18-in., f.o.b., $1.05 per lin.ft. *St. Louis*: Class "B" straight, 5x16 in., f.o.b., $1.00 per lin.ft.; roundings, $1.50 per lin.ft.

ASPHALT—Manufacturers' quotations per ton in packages (350-lb. bbls. or 425-lb. drums); also in tank-car lots, f.o.b. points listed:

	Package	Tank-cars
Atlanta (Mexican)	$20.40	$16.40
Baltimore (Standard Oil, f.o.b. refinery)	21.75	17.75
Birmingham (Mexican)	27.00	23.00
Boston (Mexican)	23.50	18.00
Chicago (Texas)	23.50	19.30
Cincinnati (Kentucky Rock)	.....	12.30
Cleveland	24.00	20.00
Dallas (Texas)	*24.75*	.....
Denver (California)	35.00	.....
Detroit (Mexican)	19.72	15.69
Kansas City, Mo. (Texas)	**35.00**	**28.00**
Los Angeles ("D" Grade, Calif., f.o.b., El Segundo)	18.00	12.00
Maurer, N. J. (Bermudez)	30.00	.....
Maurer, N. J. (Trinidad)	25.00	.....
Minneapolis, (Stanolind, f.o.b., Twin Cities)	24.10	19.10
Montreal (Imperial)	28.00	21.50
New Orleans (Texas)	24.00	21.00
New York (Texas)	22.50	18.50
Philadelphia (Mexican)	18.00	15.00
Pittsburgh (Standard Oil)	24@26	14@18
St. Louis (Mexican)	21.50	17.50
San Francisco, (f.o.b. refinery, Oleum, Calif.)	18.00	12.00
Seattle, ("D" grade, Calif., f.o.b. Richmond)	18.00	12.00

ROAD OILS—Manufacturers' quotations, f.o.b., in tank cars, 8,000 gal. minimum, per gal.:

Birmingham, 40@50% asphalt	$0.0525
Birmingham, 50@60% asphalt	.0525
Dallas, 40@50% asphalt	.05¼
Dallas, 50@60% asphalt	.05¼
New York, 40@50% asphalt (at terminal)	.05
New York, 50@60% asphalt (at terminal)	.05
St. Louis, 40@50% asphalt	.0342
St. Louis, 50@60% asphalt	.0357

Iron and Steel

PIG IRON—Producers' quotations, per gross ton, f.o.b.:

Birmingham, No. 2 fdry., silicon 1.75@2.25	*$14.00*@$14.50
Pittsburgh, basic, incl. freight ($1.76) from Valley	20.26

STRUCTURAL STEEL—Manufacturers' and dealers' quotations per 100 lb.:

	Shapes, 3 to 15-In.	Plates, ¼-In
Birmingham, large mill lots, f.o.b.	*$2.10*	*$2.10*
Chicago, warehouse, delivered	3.10	3.10
Cleveland, warehouse, delivered	3.00	3.00
Dallas, warehouse, delivered	**3.70**	**3.70**
New York, warehouse, delivered, up to 3,999 lb.	3.30	3.30
Pittsburgh, large mill lots, f.o.b., (Nov. 28, 1929)	1.90	1.90
St. Louis, warehouse, delivered	3.25	3.25
San Francisco, warehouse, delivered	3.40	3.40

BARS, CONCRETE REINFORCING—Manufacturers' and dealers' quotations on bars rolled from billets, per 100 lb. for ½-in.:

Birmingham, large mill lots, f.o.b.	*$2.10*
Chicago, warehouse, delivered	2.15@3.00
Cleveland, warehouse, delivered	2.25@2.44
Dallas, warehouse, delivered	**3.65**
New York, warehouse, delivered, over 5 tons	2.90
Pittsburgh, large mill lots, stock lengths, f.o.b.	*2.00*
St. Louis, warehouse, delivered	3.15
San Francisco, warehouse, delivered	2.25

EXPANDED METAL LATH—Per 100 sq.yd., painted, delivered by dealers to job, in less-than-carload lots:

Lb. per Sq. Yd.	New York	Birmingham	Chicago	St. Louis	Dallas	San Francisco
2.2	$20.50	*$22.00*	*$20.50*	*$20.50*	*$21.50*	$21.50
2.5	21.50	*23.00*	*21.50*	*21.50*	*24.00*	22.50
3.0	23.00	*25.00*	*23.00*	*23.00*	*26.00*	25.00
3.4	24.00	*26.50*	*24.00*	*24.00*	*30.00*	27.00

WIRE REINFORCEMENT FOR CONCRETE—Manufacturers' quotations per 100 sq.ft. in carloads at mills; and delivered by dealers, in lots of 10,000 sq.ft. or over; plain 4 in. by 4 in. mesh:

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Chicago District Mill	Warehouse Delivery: New York	St. Louis	Dallas	San Francisco
032	22	$0.99	$1.01	$1.39	$1.45	$1.13	$1.22
049	28	1.26	1.29	1.76	1.80	1.38	1.55
068	35	1.54	1.58	2.18	2.25	1.67	1.91
093	40	1.98	2.03	2.79	2.90	2.00	2.46
126	57	2.45	2.51	3.45	3.55	2.55	3.03
153	68	2.92	2.99	4.13	4.25	3.15	.....
180	78	3.35	3.43	4.73	4.85	3.47	.....

STEEL SHEETS—Manufacturers' and dealers' quotations per 100 lb., base:

	Blue Annealed No. 10 *	Black No. 24	Galvanized No. 24
Chicago, warehouse, delivered	$3.35	$4.05	$4.90
Cleveland, warehouse, delivered	3.30	3.90	4.75
New York, warehouse, delivered	3.90†	4.00	4.75
Pittsburgh, large mill lots, f.o.b.	2.10@2.20	2.75	3.50
St. Louis, warehouse, delivered	3.45	4.25	5.10
San Francisco, warehouse, delivered	4.00	5.00	5.40

*Light plates †Up to 3,999 lb.

WIRE ROPE—Discounts from manufacturers' list price on regular grades of bright and galvanized, Eastern Territory, New York, and East of Missouri River:

	Base
Cast steel round strand rope	20%
Galvanized iron rigging and guy rope (add to list)	12½%
Galvanized steel rigging and guy rope	7½%
Plow steel round strand rope	35%
Round strand iron and iron tiller	5%
Special and extra strong cast steel, round strand rope	27½%

Discount 5 points less than discount for Eastern territory: California, Oregon, Nevada, Washington, Wyoming, New Mexico, Colorado, North Dakota, Nebraska, Kansas, Oklahoma and Texas. Discount 10 points less than discount for Eastern territory: Arizona, Montana, Idaho and Utah.

RIVETS—Manufacturers' and dealers' quotations on structural rivets, round-head, ½-in., full kegs, per 100 lb.:

Chicago, warehouse, delivered	$4.00
Dallas, warehouse, delivered	4.60
New York, warehouse, delivered	4.50*
Pittsburgh, large mill lots, f.o.b.	3.10
St. Louis, warehouse, delivered	4.15
San Francisco, warehouse, delivered	5.00
Seattle, warehouse, delivered	4.25

*This price is for full kegs; broken kegs are $6.00 per 100 lb.

STEEL SHEETPILING—The manufacturers' base price, f.o.b., Pittsburgh, for large mill lots is $2.25 per 100 lb.

TERNE PLATE—I C, 8-lb. coating, 20x28-in., f.o.b., Pittsburgh mill:

Per package	*$10.70*

SHIP SPIKES—Per 100 lb., black, from dealers' warehouse stocks; galvanized are about $1.75 per 100 lb. higher:

	½-In.	⅝-In.	¾-In.
San Francisco	$5.55	$5.10	$4.95
Seattle	7.75	5.65	5.50

Pittsburgh mill base in lots of 200 kegs or more, $3.00 per 100 lb.

WIRE NAILS—Per 100 lb. keg, base, delivered from warehouse stocks; also Pittsburgh mill base:

Pittsburgh Mill	Birmingham	Chicago	St. Louis	Dallas	San Francisco	Montreal
$2.40@$2.50	$3.30	*$2.75*	$2.95	*$3.75*	**$3.25**	$4.95

SCRAP—The prices following are, f.o.b., per ton, paid by dealers:

	New York Per Gross Ton	Chicago Per Gross Ton	Detroit Per Gross Ton
No. 1 railroad wrought	$12.00@$12.50	*$13.00*@*$14.50*	*$12.50*@$13.00
Stove plate	8.00@ **9.00**	*11.25*@ *11.75*	*8.50**
No. 1 machinery cast	*12.00*@ *12.50*	15.00@ 15.50	12.00@**12.50**
Machine shop turnings	*7.00*@ *7.50*	*7.00*@ *7.50*	8.25
Cast borings	7.00@ *7.50*	*9.00*@ *9.50*	9.00
Railroad malleable	13.50@ 14.00	*14.00*@ *16.50*	12.00@**12.50**
Re-rolling rails	*11.50*@ *12.00*	*15.00*@ *15.50*	13.00
Re-laying rails, 56@60 lb.	23.00@ 24.00	21.00@ 24.00	.....
Heavy melting steel, No. 1	*11.00*@ *11.35*	*12.50*@ *13.00*	13.00
Iron and steel pipe	*9.75*	*9.50*@ *10.00*	**10.25**

*Net ton.

FREIGHT RATES—On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant-steel bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carload lots of 36,000 lb. or 18 tons:

Atlanta	$0.58	Detroit	$0.29
Baltimore	.31	Kansas City	.71†
Birmingham	.58	New Orleans	.67
Boston	.365	New York	.34
Buffalo	.265	Pacific Coast (all rail)	1.15*
Chicago	.34	Philadelphia	.32
Cincinnati	.27	St. Louis	.405
Cleveland	.19	St. Paul	.60
Denver	1.15*		

*Minimum weight on structurals, 60,000 lb. †Except iron or steel pipe and fittings.

Railway Materials and Supplies

STEEL RAILS—Manufacturers' quotations per gross ton, f.o.b., for large mill lots:

	Pittsburgh	Birmingham	Chicago
Standard openhearth rails	$43.00	$43.00	$43.00
Light rails, 25 to 45 lb.	36.00	34@36	34@36
Re-rolled rails	34.00	34@36	34@36

RAILWAY TIES—For fair-sized orders, f.o.b., the following prices bold:

		6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8½ Ft.
New York	Long-leaf sap pine, untreated	$1.10	$1.30
	Creosoted—prices on application.		
Birmingham	White oak, creosoted	1.52	1.75
	Southern pine, creosoted	*1.25*	*1.60*
Chicago	White oak, untreated	1.40	1.78
	Oak, empty cell, creosoted	1.80	2.40
	Oak, zinc treated	1.60	2.10
	Southern pine, creosoted	1.60	2.10
St. Louis	White oak, untreated	1.18	1.44
	Red oak, creosoted	1.55	1.96
San Francisco	Sap pine or cypress, untreated	.91	1.20
	Douglas fir, green, untreated	.87½	1.21
	Douglas fir, empty cell, creosoted	1.60	2.10
Montreal	Birch or maple, untreated	.75@1.25	.75@1.25
	Birch or maple, creosoted	1.20@1.30	1.50@1.60

Current Prices of Construction Materials

Railway Supplies—Continued

TRACK SUPPLIES—Manufacturers' and dealers' quotations per 100 lb. f.o.b., Pittsburgh mill, for large mill lots, together with warehouse prices at other places named:

	Pittsburgh	Chicago	Birmingham	St. Louis	San Francisco
Standard spikes, ⅜-in. and larger	$2.80	$3.55	$3.45	$3.75@$3.85	$4.35
Track bolts	3.80	4.55	5.85	4.75@4.85	5.85
Standard section angle bars, splice bars or fish plates	2.75	3.40	3.75	.....	.....

Tie plates: Price at Pittsburgh and Chicago mills, $2.15 per 100 lb.

Pipe

WROUGHT-STEEL PIPE—Discounts from manufacturers' and dealers' standard lists:

	1 to 3-In. Butt Weld		3½ to 6-In. Lap Weld	
	Black	Galvanized	Black	Galvanized
Chicago, warehouse, delivered	55.5%	42.5%	51.6%	39.0%
Cleveland, warehouse, delivered	55.5%	43.5%	53.5%	40.5%
New York, warehouse, delivered	53.74%	41.2%	50.32%	37.78%
Pittsburgh, large mill lots, f.o.b.	62%	50.5%	59%	47.5%
St. Louis, warehouse, delivered	49%	36%	46%	33%

CAST-IRON PIPE—Prices of U. S. Pipe & Foundry Co., per net ton, for bell and spigot pipe, Class B and heavier, f.o.b., on regular lots of pipe:

	4-In.	6-In. and Over
Birmingham mill	$40.00@$41.00	$37.00@$38.00
Burlington (N. J.) mill	*37.00*	*38.00*
Chicago	48.20@49.20	45.20@46.20
New York	*39.60*	*36.60*
Pittsburgh	48.50@49.50	45.50@46.50
St. Louis	45.60@46.60	42.60@43.60
San Francisco	50.00@51.00	47.00@48.00

Gas pipe and Class A, $3.00 per ton extra.

SEWER PIPE—Prices delivered, per foot, for standard pipe; 6, 8 and 12-in. are single strength and 18, 24, 30 and 36-in. are double strength:

	6-In.	8-In.	12-In.	18-In.	24-In.	30-In.	36-In.
Atlanta	$0.13½	$0.22½	$0.75	.....	.....	.....	.....
Baltimore	.....	.30	.58	.....	$1.93	.....	$6.50
Birmingham	.25	.40	.65	$1.50	2.75	$3.90	5.83
Boston	.185	.30	.555	1.35	2.25	3.70	6.50
Chicago	.15	.28	.54	1.25	2.25	4.75	6.00
Cincinnati	.135	.21	.405	1.25	2.025	3.67	5.74
Cleveland	.18	.294	.567	1.35	2.43	4.824	7.38
Dallas	*.24*	*.375*	*.68*	*1.60*	*2.85*	.....	.....
Denver	.161	.23	.414	.816	1.44	.....	.....
Detroit	.18	.28	.6075	1.50	2.70	5.12	7.91
Kansas City	.21	.29	.52	.....	1.90	3.80	.....
Los Angeles	.21	.2825	.51	1.186	2.03	3.39	5.09
Minneapolis	.16	.25	.50	1.15	1.84	3.49	4.97
Montreal	.36	.53	.78	*1.45*	2.75	4.20	.....
New Orleans	.195	.325	.585	1.10	2.11	.....	.....
New York	.185	.29	.56	1.35	2.45	4.60	7.07
Philadelphia	.117	.182	.351	1.05	1.89	3.60	5.6375
Pittsburgh	.0945	.147	.2835	.85	1.53	3.024	4.8175
St. Louis	.147	.26	.468	1.092	1.872	3.65	4.80
San Francisco	.1925	.275	.495	1.155	1.98	3.30	4.95
Seattle	.22	.30	.54	1.26	2.16	*3.50*	.....

CLAY DRAIN TILE—Prices delivered by dealers, per 1,000 lin.ft.:

Size, In.	New York	Birm'ham	St. Louis	Dallas	San Fran.	Seattle
4	$55.00	$56.00	$50.00	$63.00	$67.50	60.00
6	112.00	*85.00*	85.00	*100.00*	112.50	112.00

Miscellaneous

LINSEED OIL—Raw oil, f.o.b., in 1- to 4-bbl. lots, per lb.:

New York....*$0.152* Chicago....*$0.16* Minneapolis..*$0.167*

WHITE AND RED LEAD—Base price per 100-lb. keg, f.o.b., New York: White, dry, $13.75; White, in oil, $14.25; Red, dry, $13.75; Red, in oil, $15.25.

CHEMICALS—Water, sewage treatment, road work, round lots in the New York market:

Sulphate of aluminum, iron free, in bags, per 100 lb	$2.00@$2.10
Sulphate of copper, in bbl., per 100 lb	5.50@ 6.00
Soda ash, 58%, in bags, per 100 lb	1.32@ 1.35
Chlorine, cylinders, per lb	.04½@ .06
Bleaching powder, in drums, f.o.b. works, per 100 lb	2.00@ 2.10
Calcium chloride, in drums, f.o.b. works, per ton	20.00

MANILA ROPE—The number of feet per pound for the various sizes is as follows: ½-in., 7-ft., 6-in.; ⅝-in., 6-ft., 1-in.; ¾-in., 4-ft., 5-in.; 1-in., 3-ft., 8-in.; 1¼-in., 2-ft., 5-in.; 1½-in., 1-ft, 8-in. Following prices are quoted by dealers per pound for ½-in. and larger:

Atlanta	$0.25	Kansas City	$0.23
Baltimore	.225	Los Angeles	.205
Birmingham	.26	Minneapolis	.24
Boston	.225	Montreal	.26
Chicago	.22	New Orleans	.25
Cincinnati	.21	New York	.215
Cleveland	.21	Philadelphia	.23
Dallas	.28	San Francisco	.205
Denver	.25	Seattle	.225
Detroit	.23	St. Louis	.235

BUILDING PAPER—Black, in carloads, per roll of 500 sq.ft., f.o.b., producing point $2.08

SLATERS FELT—In carloads, per roll, f.o.b., producing point $0.91½

ROOFING MATERIALS—Prices f.o.b., New York, delivered by dealers to contractors in carloads:

Asphalt felt, per 100 lb	$2.60
Tar felt, per 100 lb	2.60
Asphalt coating, per gal	.34½
Tar pitch, in 350 lb. barrels, per ton	28.00

PREPARED ROOFINGS—Prices delivered by dealers to contractors, in carloads, f.o.b. New York, per square:

Single shingles, slate finish, sufficient to cover 100 sq.ft	$6.12½
Strip shingles, 4 in 1, hexagonal shape, with Underwriters' label	3.90
Slate surfaced roofing in rolls weighing 85 to 90 lbs	2.10

WINDOW GLASS—United inches 25, bracket size 6x8 to 10x15, single or double thickness, discount from jobbers' list (Sept. 15, 1928), at New York warehouses:

AA .....83% A .....86% B 88%

EXPLOSIVES—Manufacturers' quotations per pound for dynamite delivered in small lots, under 200 lb.:

	Gelatin 40%	Gelatin 60%		Gelatin 40%	Gelatin 60%
Atlanta	$0.22	$0.245	Los Angeles, f.o.b.†	$0.1875	$0.2225
Baltimore	.215	.2375	Minneapolis	.2275	.2525
Birmingham	.22	.245	Montreal	.20	.24
Boston	.22	.25	New Orleans	.195	.23
Chicago	.195*	.22*	New York	.255‡	.2775‡
Cincinnati	.22	.245	Philadelphia	.215	.24
Dallas	.1875	.215	St. Louis	.215	.235
Denver, f.o.b.	.19	.2125	San Francisco	.155	.18
Kansas City, Mo.	.2025	.2225	Seattle	.1525	.175

*Quantities above 500 lb. but less than a ton. †San Fernando Arsenal. ‡Special gelatin in case lots.

Lumber

Prices Are Per Thousand Feet, Board Measure

New York—Timbers, rough, delivered to contractor at site of job, in 20 ft. lengths and under, per M. ft., b.m.:

	Merchantable Long-leaf Yellow Pine	No. 1 Common Douglas Fir
3x4 to 8x8	$55.00	*$39.00*
3x10 to 10x10	65.00	*39.00*
3x12 to 12x12	75.00	*39.00*
3x14 to 14x14	87.50	*47.50*

Chicago—Prices, f.o.b., in carloads, No. 1 Common, rough, per M. ft. b.m. For delivery to job from stock, in truckloads, add $10 per M. ft.:

	20 Ft. and Under Long-Leaf Yellow Pine	Up to 32 Ft. Douglas Fir
3x4 to 8x8	$43.00	$42.00
3x10 to 10x10	50.50	42.00
3x12 to 12x12	62.50	42.00
3x14 to 14x14	74.50	43.00

San Francisco—Douglas fir, No. 1 common, rough, at yards. For delivery to contractor at site of job, add $1.50 to $5 per M. ft.:

	10-16-18 and 20 Ft.	22 and 24 Ft.
3x3 and 4	$33.00	$36.00
3x6 and 8	33.00	36.00
3x10 and 12	33.00	36.00
3x14	37.00	39.00

Other Cities—Delivered by dealers, No. 1 Common, rough, per M. ft:

	8x8-In. x 20 Ft. and Under				3x12 to 12x12-In. 20 Ft. and Under	
	Pine*	Fir†	Hemlock	Spruce	Pine*	Fir†
Atlanta	$55.00	.....	.....	.....	$65.00	.....
Baltimore	36.00	$50.00	$53.50	$61.00	75.00	$50.25
Birmingham	**53.00**	.....	.....	.....	**80.00**	.....
Boston	48.50	47.00	47.50	48.50	58.00	52.00
Cincinnati	52.50	62.50	.....	.....	70.00	57.50
Cleveland	65.00	65.00	.....	.....	65.00	65.00
Dallas	65.00	57.50	*55.00*	55.00	65.00	*55.00*
Denver	.....	57.00	57.00	55.00	.....	58.00
Detroit	*55.00*	**53.00**	.....	.....	*68.50*	**53.00**
Kansas City, Mo.	60.00	60.00	.....	.....	**67.00**	**67.00**
Los Angeles	.....	44.00	.....	.....	.....	44.00
Minneapolis	58.00	*52.25*	38.25‡	.....	58@60	*52.25@53.75*
Montreal	.....	.....	.....	.....	56.00	48.00
New Orleans	50.00	46.00	.....	44.00	*50.00*	*48.00*
Philadelphia	50.00	43.00	42.00	48.00	60.00	43.00
Pittsburgh	65.00	70.00	75.00	65.00	65.00	65@72
St. Louis	49.00	45.00	.....	.....	61.00	44.00
Seattle	.....	22.00	.....	.....	.....	21.00

	1x10 In. x 16 Ft. and Under			2x10 In. x 16 Ft. T. & Gr.	
	Pine*	Fir†	Hemlock	Pine*	Fir†
Atlanta	$60.00	.....	.....	$42.50	.....
Baltimore	56.00	$45.00	$45.00	.....	.....
Birmingham	36.00	.....	.....	**45.00**	.....
Boston	45.00	43.00	42.50	48.50	$47.50
Cincinnati	65.00	57.50	.....	42.00	55.00
Cleveland	60.00	55.00	.....	65.00	58.00
Dallas	60.00	.....	.....	.....	.....
Denver	.....	**45.00**	46.00	.....	**52.00**
Detroit	**47.50**	**45.00**	.....	48.50	47.00
Kansas City, Mo.	**56.00**	**56.00**	.....	49.00	49.00
Los Angeles	.....	38.00	.....	.....	57.00
Minneapolis	53.00	*46.00*	39.75‡	51.00	*45.00*
Montreal	56.00	.....	.....	.....	.....
New Orleans	43.00	40.00	.....	50.00	46.00
Philadelphia	52.00	43.00	41.00	55.00	44.00
Pittsburgh	50.00	60.00	59.00	42.00	.....
St. Louis	45.00	42.00	41.00	41.00	39.00
Seattle	.....	20.00	.....	.....	21.00

*Long-leaf yellow pine. †Douglas fir. ‡F.o.b.

PILES—Per lineal foot, pine, with bark on, f.o.b., New York; delivered from barge, 1½ to 2c. per ft. additional:

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14½	$0.18
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.19	.23
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.21½	.25
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.25½	.34
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.27½	.36
14 in.—2 ft. from butt	5 in.	80 to 85 ft.	.33	.41
14 in.—2 ft. from butt	5 in.	85 to 89 ft.	.38	.41